RAILROAD GAZETTE

SATURDAY, JUNE 5, 1875.

The Musconetcong Tunnel.*

BY HENRY S. DRINKER, E. M.

Members of the Society on reading the following paper will bear in mind that, though presented at the New Haven meeting, in February, 1875, its publication has been deferred at the request of the author, until May, 1875, that full data of progress, etc., in the various departments of work might be given, up to the completion of the tunnel.

The Musconetcong tunnel is situated in New Jersey, near the line of the Central Railroad of New Jersey, about 12 miles from Easton, on the Easton & Amboy Railroad, the latter being the extension of the Lehigh Valley Railroad to tide-water. Up to the present time the terminus of the Lehigh Valley Railroad has been at Phillipsburg, N. J., opposite Easton, passengers connecting there with New York, by the Morris & Essex, Delaware, Lackawanna & Western and New Jersey Central lines, freight and coal being forwarded by the Morris & Essex to tide-water at Hoboken, and by the Central Railroad to Elizabethport and Port Johnson; also by the Belvidere & Delaware connections through Trenton to South Amboy.

By the Easton & Amboy route the Lehigh Valley Railroad will possess a direct through road for its heavy coal and freight traffic to tide at Perth Amboy, passengers for New York connecting at Metuchin with the Pennsylvania Railroad (Camden & Amboy).

Preliminary lines having been run, the first location was decided on in the autumn of 1871 and winter of 1872, it being such, with regard to alignment and grades, as to insure the greatest economy in conducting transportation. Construction was commenced in the spring of 1872, and, from the first, the tunnel was especially pushed from being the heaviest piece of work on the line. The road, on being ready for construction, was subdivided into four divisions. Robert H. Sayre, Esq., Chief Engineer of the Lehigh Valley Railroad, being also Chief Engineer of the Easton & Amboy extension; Calvin E. Brodhead, Esq., Principal Assistant. The tunnel was located in Division I, John L. Wilson, Esq., Division Engineer, and Henry S. Drinker, Resident Engineer. Mr. Charles McFadden, of Philadelphia, took the contract for the tunnel, and for several miles of construction adjoining each extremity.

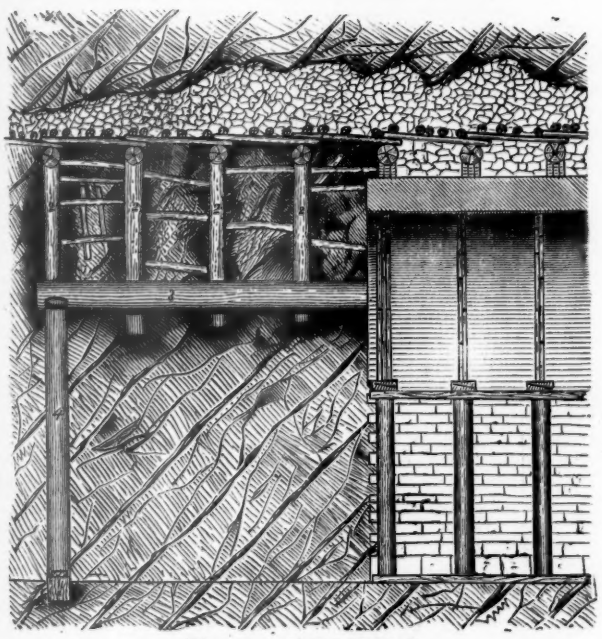


Fig. 11—*Scale, 10 feet to 1 inch.*

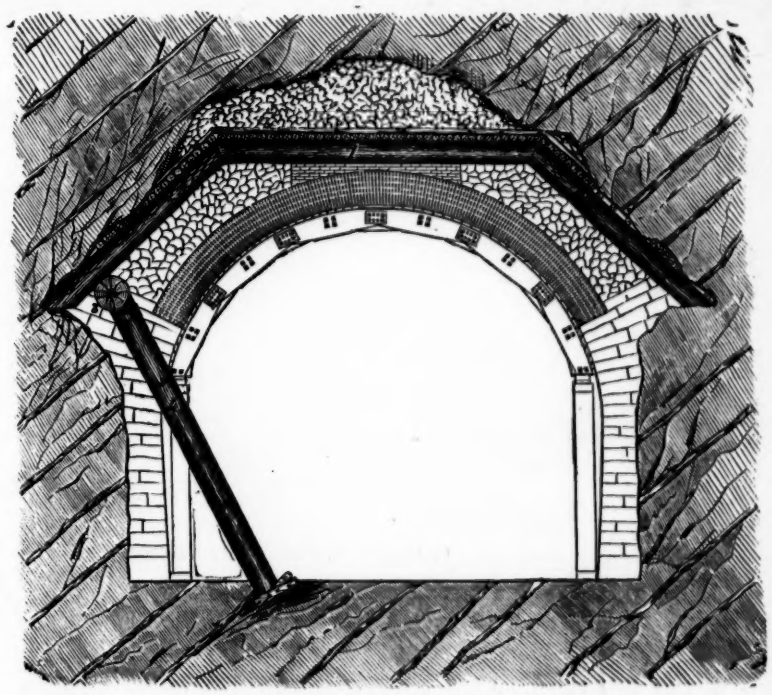


Fig. 12—*Scale, 10 feet to 1 inch.*

Musconetcong Mountain is one of a range around or through which a road from Easton to New York must go. Its summit is about 900 feet above tide-water and 470 feet above the grade summit, which occurs in the middle of the tunnel, the one adverse grade to transportation occurring in the whole length of the road being between Phillipsburg and this point. The total length of the tunnel is a little less than a mile, it being, with the exception of the Hoosac, the longest east of the Mississippi.

By consulting Fig. 1, the general formation of the mountain and the location of the different parts of the work may be observed. It will be seen from it that the preliminary top headings (shown by broken lines) passed through 770 feet of soft ground at the west end; 702 feet of this was subsequently arched, the balance being taken out in open cut. Next occurred 460 feet of limestone, and then 3,731 feet of syenite, the latter continuing without change out to the eastern entrance. At the junction of the limestone and syenite, some 263 feet of arching was required, as the rock was found for some distance on either side of the line to be very loose and seamy.

This syenite may, in reality, be called a syenitic gneiss for the greater part of its length, as it seems to have a distinct stratification, the dip through both it and the limestone being invariably to the east, or against the mountain on the west side. In Fig. 1 it will be observed that the first rock met at the west end was a roll of limestone, occurring with an anticlinal axis in the open cut; this next gave way, for some hundred feet, first to bands of decomposing, shaly limestone, and, possibly, some strata of Prime's "damourite," and then to seemingly stratified layers of red and white clay. Syenite was then encountered, with an anticlinal axis, evidently *in situ*, but partially decomposed, being most solid in the center of the roll, where it required blasting. Then came another formation of clay, next occasional boulders, with much water; and then, with an adverse dip to the mountain, limestone again—the latter continuing, and meeting the syenite with this same adverse dip.

Before meeting the syenite, and near the junction, a large body of water was struck, and the limestone for some 50 feet was somewhat disintegrated, largely impregnated with iron pyrites, and the syenite, after the junction, continued soft and seamy for over 200 feet before becoming hard enough to support itself; arching was necessary through both the soft ground and under the loose rock. Between the syenite and limestone there occurred only a small vein of about 6 inches of soft, decomposed rock, with no intervening stratum of either slate or Potsdam sandstone. The syenite preserved mainly the same dip to the east, throughout its total length, except for some distance about the middle of the formation, where it seemed massive (shown in Fig. 1 by crossed lines). Now, without hazarding any positive assertion on the subject, where so many plausible theories might be advanced, the suppositious formation, as shown in Fig. 1, is offered to account for the position of the strata. It seems somewhat plausible, and if carried out, would make an anticlinal axis in the syenite somewhere in the east heading, probably. This would account for the parallelism of the dip on both sides of the mountain, and for the limestone underlying the syenite at the west end. At the east end no limestone was found, and no outcrop observed on the west slope, it being, probably, denuded, and only preserved in the supposed synclinal fold, as shown at the bottom of the slope.

The approach at the west end is through a cut about half a mile long, running from grade to about 75 feet of cutting at the entrance, mostly through earth, with some limestone rock, and a part through a soft, whitish clay, resembling kaolin, which latter gave much trouble, the steam shovels, two of which were used, settling in it constantly.

This deep cutting at the west end, which we will treat of first, as it was by far the heaviest work, made it necessary to begin the tunnel by sinking either a shaft or slope to grade. A slope was decided on, and it was located so that its foot reached tunnel grade about 850 feet from the west end. This location was made that the solid rock might be soon reached and a heading started at once to the east. Then, while it was being driven, the open cut could be brought up, and any soft ground encountered between the slope and entrance arched.

Ground was broken for the slope in April, 1872; dimensions 8×20 in the clear; length to grade of top heading, 276 feet, on an angle of 30°. It ran 190 feet through earth, necessitating timbering; collars of 12-inch oak, 4 feet apart from center to center, supported by end and 2 middle props, lagged at the sides and above with chestnut forepoling. The remaining distance was through good limestone rock, dimensions 8×16, the average progress through both rock and earth being from 7 to 10 feet per week, as shown in Table I. On reaching grade of tunnel roof, on November 13, 1872, top headings were started east and west, 8 feet high × 26 wide, by hand labor; progress, after getting fairly started, being in No. 1, or the heading driving east, in December 40, in January 57 feet. The work went on favorably in this heading during the winter. Machine drilling was introduced in February, raising the progress at once in February to 69 feet, and in March to 95 feet, a rate subsequently very much increased after getting the machines in full working order, as will be shown. In April, when the face had advanced about 275 feet from the foot of the slope, the rock began to show signs of disintegration; the amount of water coming in increased, and the roof became so heavy that it was found necessary to timber it with collars of 15-inch oak, set about 5 feet apart from center to center, lagged above, and sometimes at the sides, and supported either on legs, or by hitches in the rock. These collars (1) were put in high enough to clear a 2-foot ring of masonry (Figs. 11 and 12), and about them, packing was securely blocked in, up to the roof.

On May 7, 1873, about 3 p. m., a head of water was struck, first by a 2½ inch drill-hole, about 4 feet above the floor of the heading. The water forced the drill back and shot some fifty or more feet out into the heading in a steady stream, seeming to come from some large, pent-up reservoir. At 5 p. m. it was rising so fast that it was found necessary to take out the drills and pumps, to save them. At this time there had been two steam pumps at work; one No. 7 Niagara, and one No. 5 Knowles. The water caught the last before it could be removed and hoisted. The Niagara was moved up the slope during the night, but it could not keep back the water, which continued steadily rising; so it was taken out, and another similar one sent for, so that the two could be set to work on the water reaching its level.

The water still rose through the next day, but on the 9th it reached its maximum elevation within 120 feet of the top of the slope or 70 feet beyond the junction of the limestone rock and earth, so giving cause to fear that should the water not be soon removed it might undermine the props of the slope timbering, and start the earth to working above the collars and at the sides, it being very treacherous material when moistened. On the 10th, the new pump arrived, and the two set to work, throwing, it was estimated, about 1,500 gallons a minute. On the 14th, the water was lowered 20, and by the 15th, 40 feet, by incessant work, gaining back a few feet every time the pumps were moved down, and the latter had to be run at such a rate that they were soon badly racked. However, the pumping was being vigorously pushed, when suddenly, about 1 a. m. on the 14th, the water being at that time nearly 50 feet down, several sets of timber at water level, and others below, gave way, the breakage subsequently continuing up to the surface of the ground, some hundred or more feet above.

The breakage, it will be noted, (Fig. 1), occurred at, and just above, the junction of the rock and earth, and seemed to be caused by the water having eaten away the backing of the side props sufficiently to allow them a chance to sag outward, so throwing increased pressure on the roof. This disaster would practically necessitate a new driving and complete re-timbering, in all probability, of all the slope through earth below the level the water first rose to, as it was all in a dangerous condition, and this in the face of a head of water so strong that it would probably be impracticable to keep it back with such pumps as there would be room for while carrying on so difficult and delicate a task as re-timbering ground so heavy as this, after having started "running."

It was thereon decided by the Chief Engineer to sink a shaft, locating the same about 420 feet west of the bottom of the slope, the object being to push headings east and west from the shaft to tap and carry off the water from the slope workings to the open cut. On the 16th, the shaft was commenced at 1 p. m. It was so located as to clear 4 feet on the left and 12 feet on the right of the center line of the tunnel. It measured 8×16 feet in the clear, timbered with 12-inch square white pine sets, placed at first touching, and lower, about 2 feet 6 inches apart in the clear; some of these latter sets were subsequently strengthened with liners. It was also strengthened from top to bottom by 12-inch pine braces, and by them divided into a 7-foot compartment on the left, for pumps and tubing, and an 8-foot one on the right for a hoistway. The shaft reached grade of the top heading, 110 feet down, in five weeks, on June 21, 1873, having been driven and timbered at the rate of 25 feet per week.

We may note that while the heading was being pushed east from the bottom of the slope, the one coming west was also driven on, but not so rapidly, so that when the slope workings were flooded, the heading coming west was advanced about 125 feet, its face being still in limestone rock, with 290 feet yet between it and the shaft. It was driven 26 feet wide by 7 feet high. To meet this, heading No. 3 was at once started east from the bottom of the shaft through earth, its dimensions in the clear being: top width, 8 feet; bottom width, 10 feet, by 8 feet high. This was timbered in the ordinary manner (figs. 15 and 16) with oak collars and props of 12 to 15-inch round timber; sets placed from 2½ to 2 feet apart from center to center, footed, in very soft ground, on 6-inch sills, but ordinarily on 3-inch foot blocks. A similar heading (No. 4) was at the same time started west toward the open cut, the top bench of which was sufficiently advanced by the 30th of August to allow a shaft 32 feet in depth to be sunk at a point about 20 feet west of the proposed mouth of the tunnel. This reached bottom September 13, 1873, and a fifth heading (No. 5) similar to Nos. 3 and 4, was started from this shaft east to meet No. 4 and driven at an average rate of 33 feet per week through earth.

To return to No. 3, or the heading driving east from the main shaft, to tap the slope workings. During July it was driven and timbered through earth at an average rate of 20 feet per week, this rate being raised in August to 30 feet per week; at the same time the adjoining heading, No. 4, was driven at first at an average rate of 25 feet per week, and in September of 28, 36, 39, and, at the highest, 41 feet per week; the force required being generally 2 miners, 2 helpers, 2 laborers, and a boss or foreman.

When No. 3 had reached a point 165 feet from the shaft, still in earth, on August 13, 1874, a large body of water was tapped in the face, there being at that point about 124 feet remaining between headings 2 and 3. The water was struck about 8 p. m., and rushed in with great force; it was estimated at not less than 3,000 gallons per minute, or four times the capacity of the pump. This flow rapidly enlarged the original aperture, the material being soft. The men working in heading No. 4 had barely time to escape, as the shaft was quickly filled with water some 40 feet up and the pump submerged.

Two No. 7 Niagara pumps were at once placed on the cage, lowered to water level and started; while gaining on the water, they did not lower that standing in the slope, leading to the unpleasant inference that this was a new reservoir, and that shortly all Jersey might be in with a determined effort to prove herself most indubitably interested, at last, in the cold water movement. By the 19th of August the water was pumped out, and it was found that, far from being exhausted, it had, in fact, dammed itself, the heading being completely blocked with sand half the distance from the face to the shaft. This was nearly cleared by the 21st, when, at 9 a. m., the water again broke in, this time bringing more sand with it, stopping the flow quicker, so that the water only rose some 25 feet in the shaft.

It was again pumped out by the 22d, at 10 a. m. After a delay of about a week, the heading was again cleared and an attempt made to drive it, by keeping a strong oak plank dam ahead. This was put in about 20 feet back of the old face, the planking being caught at the ends by the heading props. A crevice below the bottom plank allowed the water to run out, and, the top plank being removed, enough material was dug out to allow this plank to be put forward and braced against the next set of props. Then the second plank would be advanced likewise, and so down to the bottom; by this method a continuous dam being constantly kept up. With this the work was pushed through the 20 feet of sand up to the old face again,

*A paper read before the American Institute of Mining Engineers at New Haven, Conn., February 25, 1875.

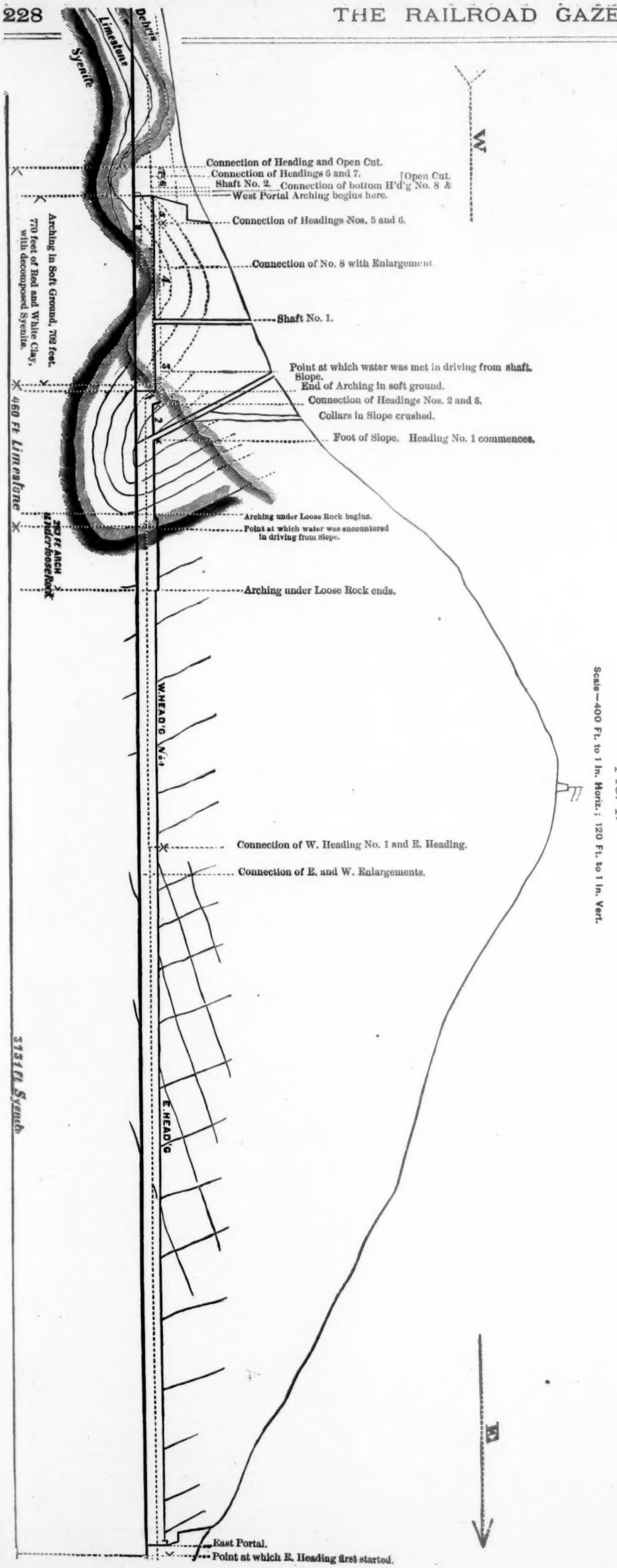

Syenite
Limestone
Débris
Connection of Heading and Open Cut.
Connection of Headings 6 and 7.
Shaft No. 2.
Connection of bottom H'd'g No. 8 & Open Cut.
West Portal Arching begins here.
Connection of Headings Nos. 5 and 6.
Connection of No. 8 with Enlargement.
Shaft No. 1.
Point at which water was met in driving from shaft.
Slope.
End of Arching in soft ground.
Connection of Headings Nos. 2 and 3.
Collars in Slope crushed.
Foot of Slope. Heading No. 1 commences.
Arching in Soft Ground, 703 feet.
770 feet of Red and White Clay, with decomposed Syenite.
460 ft Limestone
252 ft ARCH in Loose Rock
Arching under Loose Rock begins.
Point at which water was encountered in driving from Slope.
Arching under Loose Rock ends.
W. HEAD'G
Connection of W. Heading No. 1 and E. Heading.
Connection of E. and W. Enlargements.
E. HEAD'G
3351 ft. Syenite
East Portal.
Point at which E. Heading first started.
W
E
Scale—400 Ft. to 1 In. Horiz.; 120 Ft. to 1 In. Vert.

FIG. 1.

which was reached on September 8, when, an attempt being made to drive on the heading, the water again broke in, at 4 p. m., with such irresistible force that in spite of every effort it broke through the dam and again drove out the men, filling the headings and part of the shaft. By 1 p. m. on the 9th, the water was again pumped out, and the men started to clearing up. Meantime the headings 4 and 5, designed to connect the shafts, had been pushed as rapidly as possible, work on No. 4 being resumed whenever the water was out of the shaft, and on October 7 connection was made, so that in case of flooding the water could be pumped from both shafts at once. Work was again resumed in No. 3, with a dam ahead as before. On reaching the water, it again proved too strong, and drove the men out on the 13th, at 6 p. m. It was pumped out through the two shafts by 1 a. m. on the 14th. It was now decided by the Chief Engineer not to resume work on the main heading at once, but to leave the sand in the face as a dam, and to try to tap the water, by starting a cross-cut (Fig. 4), 4 feet wide by 6 feet high, at a point (B) about 25 feet back of the face (A). This was driven at right angles to the line of the tunnel, north 14 feet, thence ahead, parallel to the main heading, to a point (C) a few feet in advance of the face, thence south again about 6 feet. This was done without meeting water, so, on October 23, at 1 a. m., an attempt was made to tap the water, by boring ahead through the earth with a 3-inch augur, but unsuccessfully, so it was decided to drive on the parallel heading, and also to make another attempt to either drive on or get a steady flow of water in the main heading; the trouble being always that there was no chance to exhaust the body, as it invariably dammed itself, after doing all the damage possible. On getting up to the face of the main heading, the water came in again in the bottom on November 4, at 10 p. m., but this time was mastered by the miners quickly throwing across three dams in succession in which the sand lodged, so that it only rose some 2 feet above the bottom, without attaining a steady flow. The parallel heading, meantime, had been pushed on to a point (D) about 17 feet in advance of the face of the main heading, making its total length 42 feet, and another cross-cut was driven south about nine feet, toward the line of the tunnel. In it, by boring, the water was tapped on Nov. 8 at 9 p. m., it seeming to lie between a lot of loose boulders in sandy soil. The pumps were run to the limit of their capacity, at first keeping the water under control; but at the end of three days, being racked by incessant work they gave out, and it rose to the top of the heading. By this time the steam shovel had advanced the second bench of the open cut to within 55 feet of the second shaft, from which a heading, No. 6, had been driven 32 feet west in October in readiness to meet the shovel. A heading was now started, Nov. 17, in from the open cut, clearing the remaining 23 feet by Nov. 20, so giving, at last, a free vent to the water, which thereon spent its force in about 40 minutes, running the headings full, and spouting out in a huge jet, then subsiding into a clear running stream, carried by a ditch in the center of the heading. Driving on the main heading (No. 3) was resumed and it advanced in the next three weeks, still in earth, at an average rate, at first, of 30 feet per week; then, meeting the limestone at a point about 240 feet from the shaft, progress was reduced to 20 feet per week.

Meantime, the water standing in the slope remained stationary at its first level. By the first of October, however, it had gradually lowered to some 170 feet from the top, or the point to which the pumps had reduced it when the timbers broke, so that now it was found possible to keep the water down before the miners, the heavy head being off. The miners were therefore started to clean out and repair the damaged portions of the slope, and as soon as the water, on November 20, found a permanent outlet through the shaft headings, it at once sank in the slope to the level of the top of the heading, or roof of the tunnel. Now the height of the tunnel through rock is 18.4 feet above base of rail. When arched it is 21 feet in the clear above base of rail. Adding to this a 2.5 feet ring gives 23.5 feet to crown of arch; but the bottom of the collars, in a preliminary top heading through soft ground, must clear 3.5 feet above the crown of the arch, to allow room for working the subsequent drawing bars in enlarging, as will be explained hereafter. This makes the bottom of the collars in the soft ground heading 27.0 feet above base of rail, or 8.6 feet above the roof of the tunnel through rock. As the soft ground heading was driven about 8 feet high in the clear, its floor barely came on a level with the average top of the rock heading from the slope, as shown in Fig. 1, so that the advantage gained and desired by tapping the water in the shaft, was simply to take its head off, the steady stream that subsequently ran in the slope workings being pumped out at the slope, by, at first one, and as the heading advanced, two No. 7 Niagara pumps.

Work was resumed in headings Nos. 1 and 2 about January 1, 1874, and on the 3d, headings 2 and 3 met, thus affording connection between the shaft and slope workings, and leaving only the west heading, No. 1, from the bottom of the slope east, and the east heading, which had been from the first driving steadily west, with about 2,335 feet yet to drive between them. As No. 1 advanced, the water was found to have been tapped by the drill-hole that first struck it, in a run-way in the limestone, about two feet wide, cutting across the line of the tunnel. The rock was found to continue so bad that it was decided unsafe to put in the machines, the constant jar being too heavy in loose rock.

The dividing line between the limestone and syenite was soon reached. Water was also constantly met in new springs as the headings advanced, so that the contractor for a long time was obliged to keep his pumps going steadily; indeed, until the open cut was brought up to grade, and the bottom heading, that was subsequently driven, connected with the rock enlargement.

After passing the dividing line of the limestone and syenite, the rock continued loose for some two hundred feet, requiring timbering all the way as described above, when the loose limestone was first met in this heading. Through all this loose rock the packing ran regularly from four to five feet above the collars, and occasionally as high as from 6 to 8 and even 10 feet, the collars being always put in so as to just clear a two-foot ring of masonry. This, of course, gave an immense amount of loose rock to remove, and retarded the progress of the work so that the advance gained did not exceed an average of 40 feet per month until the middle of May, 1874, or about one year from the time the water first broke into the heading. Solid rock being reached, the drilling machines were put in, and the work at last might be called fairly started, with about 1,725 feet of hard syenite still between headings; one of the hardest rocks, except trap, that has been encountered in tunneling in our Eastern States—harder and tougher, it is said by judges familiar with both, than any body of rock encountered in the Hoosac tunnel.

And now a word as to these drilling machines.

At the west end four Burleigh compressors were used to run the drills. These compressors were what are known ordinarily as the "two-drill compressor," consisting of two vertical air cylinders run by a horizontal steam engine. They have the great merit of being extremely simple in construction, and have won a well-deserved reputation by the work they have done at Hoosac, Nesquehoning, and elsewhere. By consulting Fig. 5, a section of the air cylinder, it will be seen that the pistons (*a*) of the air cylinders are worked from a shaft, the cranks, *b* and *c*, of which are at an angle of 180 deg. With these the motor crank, *e*, forms an angle of 45 deg., so that the greatest work of the motor piston is designed to correspond with the greatest resistance offered to the compression piston. The valves, *f* and *g*, are circular plates held in place by vertical guides. The compressed air from the two

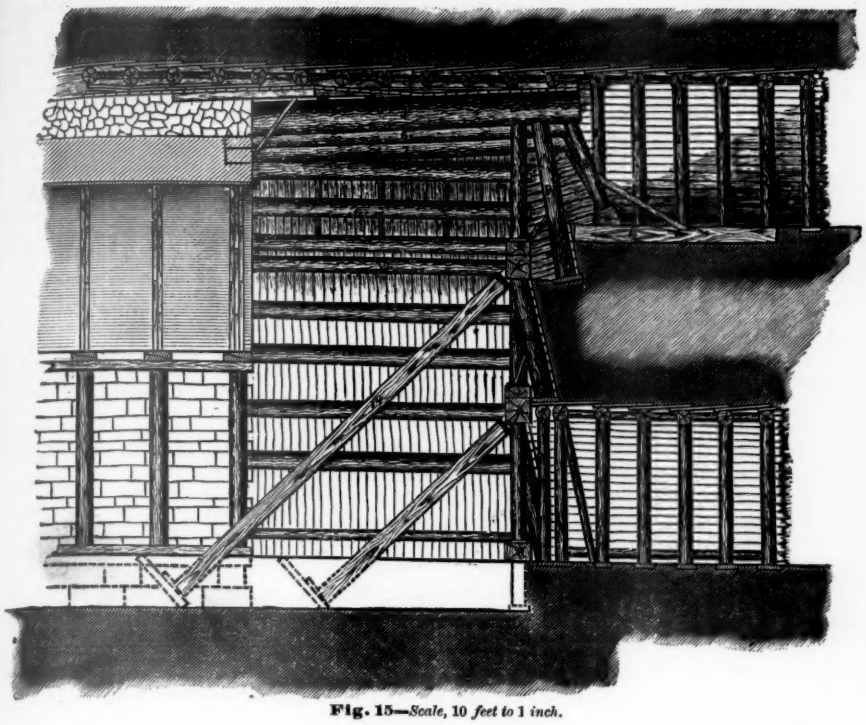


Fig. 15—*Scale*, 10 *feet to* 1 *inch.*

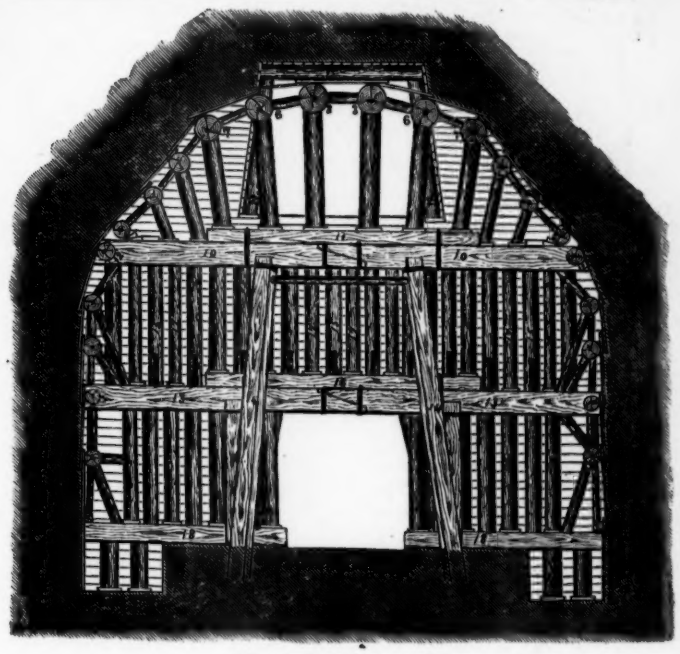


Fig. 16—*Scale*, 10 *feet to* 1 *inch.*

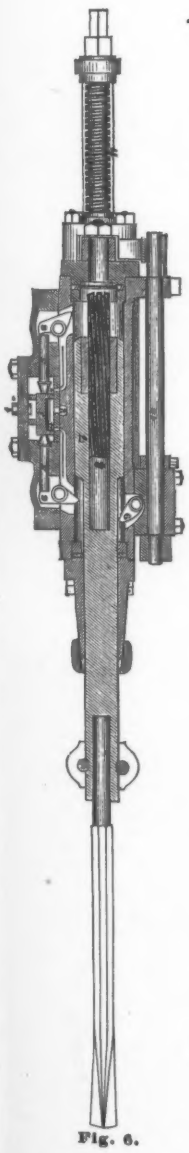


Fig. 6.

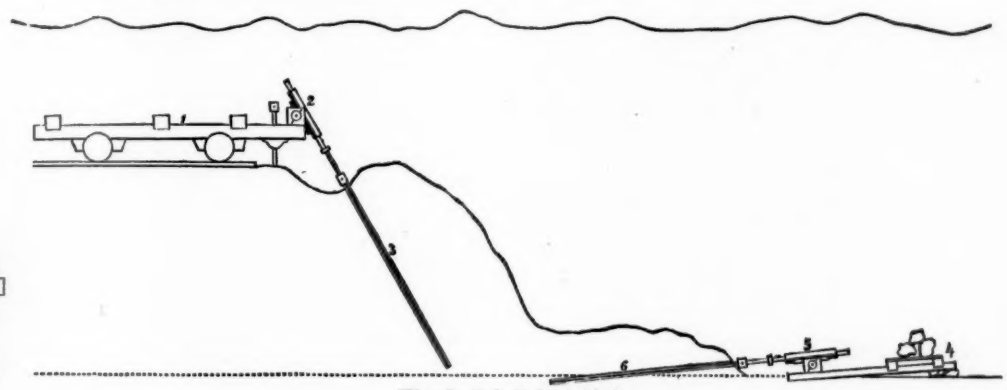


Fig. 9—*Scale*, 10 *feet to* 1 *inch.*

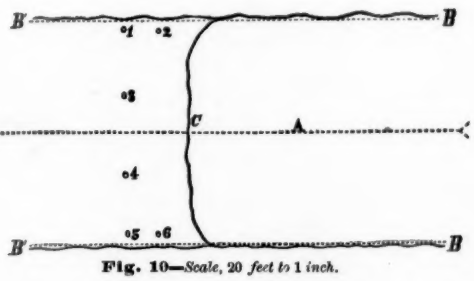


Fig. 10—*Scale*, 20 *feet to* 1 *inch.*

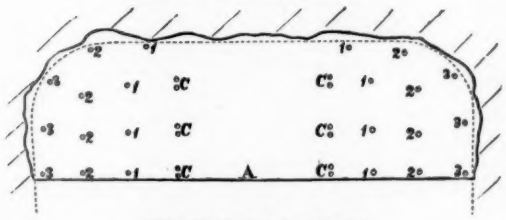


Fig. 8—*Scale*, 10 *feet to* 1 *inch.*

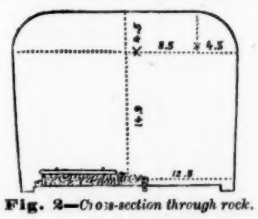


Fig. 2—*Cross-section through rock.*

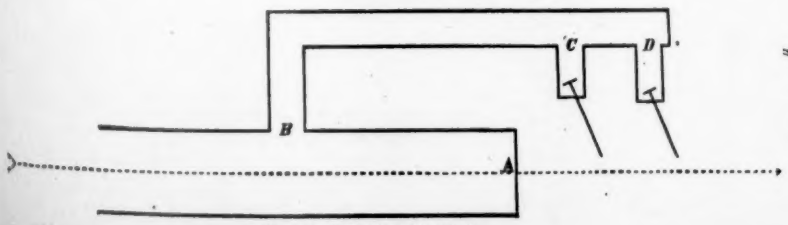


Fig. 4—*Scale*, 20 *feet to* 1 *inch.*

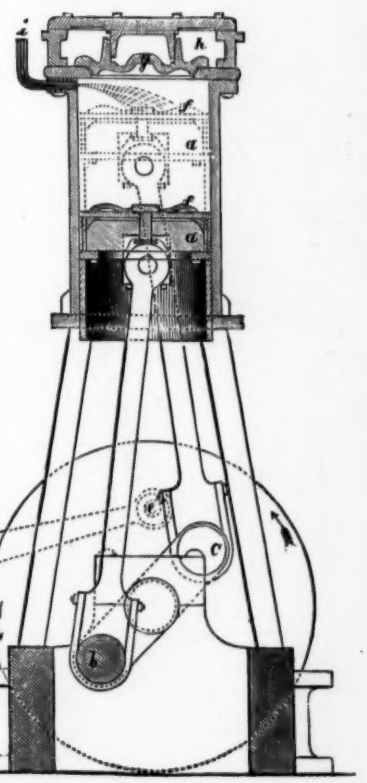
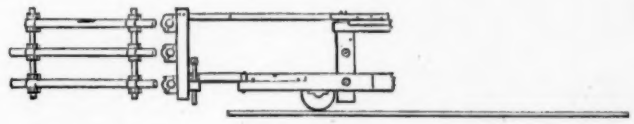


Fig. 5.



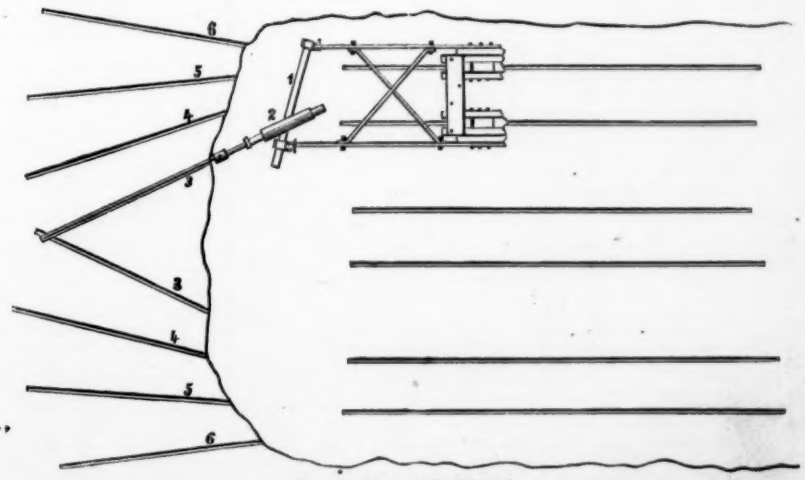


Fig. 7—*Scale*, 10 *feet to* 1 *inch.*

cylinders is driven into a common chamber, *h*, and thence conducted by pipes to a receiver, which serves to ensure an equalized pressure, and from the bottom of which any water carried over by the air and condensed is tapped at intervals. This water is admitted in a jet through the pipe, *i*, and serves to cool the cylinders, and in working down assists also as a lubricator. Four of these compressors were found sufficient to run the nine drills usually kept going in the heading and bench. To furnish steam for them four return tubular boilers of 45 h. p. each were used. The compressed air was conducted by a six-inch pipe, at first about 1,300 feet, and before the headings met about 3,000 feet, before reaching the drills, and it was observed that the loss of pressure rarely exceeded from 2 to 3 lbs., and generally was still less.

The Ingersoll drill was adopted by Mr. McFadden after a careful trial, and used throughout the prosecution of the whole work, giving entire satisfaction. At first 3¼-inch and then 4-inch drills were tried, but finally the 5-inch was decided on as by far the best size in the hard rock encountered. Fig. 6 shows a section of this drill, which sufficiently explains the principle on which it works, 1 being the feed; 2, exhaust; 3, valve; 4, ports; 5, valve-stems; 6, tappet; 7, piston; 8, an eight-thread screw fitting into the piston, which thereby receives the rotary motion necessary; 9, tappet from which the motion is communicated by the bar, 10, to a pawl and ratchet movement acting on the feed screw 11. This is the so-called "improved Ingersoll drill," and, it will be observed, the tappets and valve-stems are entirely concealed by being placed inside, thus being protected from accident by careless workmen in starting the drill, as with this they are confined in starting to simply slightly moving a small lever, or sometimes a ring connected with the tappet arm. This style of drill was found to run months with little or no repairing necessary, and what repairs were necessary, were generally more in consequence of wear than breakage, the parts giving out first being usually the feed pawls and ratchets.

The drills were mounted in the heading on two carriages, one on each side of center line. These carriages were simply stout frame-works of oak, running on tracks carried up to the face of the heading, each supporting in front three horizontal iron bars, on which the drills were so clamped as to ensure convenient lateral and vertical motion. Fig. 7 shows a front and side view, and plan of the fore-part of one of these carriages, there being two in the heading, one on each side. After a blast, all hands are at once engaged in shoveling and filling the broken rock into the middle of the tunnel between the machine tracks, so as to clear the latter. As soon as the way is clear, the carriages are at once run up to the face, and drilling recommenced, and the broken rock subsequently removed by cars on a center track. The heading being 26 feet wide, there was room enough to accommodate the three tracks, and by proper switching there was rarely any detention from want of cars. As to the manner of drilling holes, the west heading, after passing the loose rock, was all broken by the method of center cuts, and subsequent squaring up. This method was introduced at Musconetcong by Mr. Wm. White, Superintendent of mining for Mr. McFadden, and formerly Superintendent for Shanly Bros., at the west end of the Hoosac tunnel. To his efficient management of both the rock and subsequent heavy timber work at the west end is due much credit for the rapidity and thoroughness with which the work was completed. Giant powder or dynamite was adopted as an explosive by Mr. McFadden. It is sold in two grades, as No. 1 and No. 2, No. 1 being much the stronger and quicker in its action. Their composition, etc., will be explained hereafter.

This method of blasting by cuts is based, of course, on the extraordinary force developed by a comparatively small bulk of explosive matter. It consists in first blasting out an entering wedge or core, about 10 feet deep at the center, and subsequently squaring up the sides by several rounds. To do this, first 12 holes are drilled by the six machines, three on a side, the holes placed as shown in Fig. 8, and marked C; A being the floor of the heading. These 12 holes are drilled two and two, six on a side, with from 1¾ to 2¾ inch "bite," the two sets being started about nine feet apart, and at such an angle as to meet or cross at the bottom, the largest bits being put in first. They are then charged with about 25 lbs. No. 1 and 50 lbs. No. 2 giant powder, and fired simultaneously by electricity. No. 1 is only used for cuts, inasmuch as in them a quick, strong powder, comprised in a small bulk at the bottom of the holes, is required, where the greatest resistance will be found, while the No. 2 added, serves in filling the holes, so starting the sides of the cut as the apex moves. The cut being out, a second round of holes is started for the first squaring up, as shown by the numbers 1, 1, 1, 1. In these, and in the subsequent rounds, 2, 2, 2, 2, and 3, 3, 3, the resistance is pretty equally distributed along the whole length of the holes, and is also, of course, not so great as in the cut; therefore No. 2 is used, as in it the nitro-glycerine being mixed with a larger proportion of absorbent matter, the force is thereby distributed over a greater space.

In the first and second squaring up rounds, from 50 to 60 lbs. of No. 2 are charged, and in the third, from 80 to 90, the holes getting stronger as the arch falls at the sides; there are generally also one or two additional roof holes in the third round that are not shown in the figure, their position being variable, according to the lay of the rock. The top holes in the first round are also designed to bring down any roof not shaken by the cut, and are therefore given a strong angle towards the center, and always drilled from 12 to 14 feet deep. The horizontal projection of the above holes is shown in Fig. 7, 3, being the cut holes, 4 5 and 6 the squaring up rounds. As to their relative depth, the holes of the first squaring round are always drilled a foot or more deeper than the cut holes, and when blasted, they generally bring out a foot additional of shaken rock at the apex of the cut. The following table will approximately show the number and depth of holes required, and the powder used for a lineal advance of ten feet in heading work:

	No. of Holes	Depth of Holes.	Total Depth of Holes.	Lbs. No. 1.	Lbs. No. 2.
Cut	12	10ft.6in.	126	25	50
1st square up	8	12	96		55
2d square up	8	12	96		55
3d square up	6	12	72		85
Additional roof holes	2	{10 / 8}	18		
	36		408	25	245

Now, allowing the cut holes to be 10½ feet deep, the cut will generally blast out about 9 full feet linear, which, as explained above, is raised to 10 in the subsequent rounds.

Assuming the average cross-section in an eight-foot heading to be about 175 feet, for a lineal advance of ten feet, 65 cubic yards of rock would be broken, which would give an average of say four-tenths (0.4) lbs. No. 1, and four (4) lbs. No. 2 giant powder burnt, and a little over six feet of holes drilled, per cubic yard broken.

This, however, it should be noted, would often be increased by occasional block or side holes, and is assumed for a case in in which no holes are supposed to have missed, and in which no secondary drilling and blasting is required. Proportionate amounts would have to be added for such cases.

The above estimates are based on ordinary ten feet cuts; there were, however, many instances of 12 and 13, and sometimes 14 feet cuts taken out by ambitious foremen, but even giant powder has its limit of strength, and working too deep cuts is not advisable, as they will often only blow out partially, leaving the rock in awkward shape. As to the division of time in heading work, to drill and square up a cut should take about 4 eight-hour shifts, with such rock as was met at Musconetcong, it being, as stated, unusually hard and tough. It will take one shift to drill and blast the cut and one shift to each of the three rounds, and this with a force of 12 machine men (one driller and one helper to each machine), 6 laborers for loading broken rock, 1 nipper for carrying tools, and a boss. On an average, however, this standard will hardly be reached, as it provides for no stoppage, no missed holes, and no accidents, and, unfortunately, tunnel headings, like all things earthly, are liable to occasional stoppages and accidents. However, a standard approximating this can be attained, and was attained in the west heading at Musconetcong, in the latter part of the work. With the advanced stage drilling machinery has attained, engineers might now turn their attention more fully to devising increased facilities for the more economical removal of broken material; beyond a certain point it will be of no avail to reduce the time of the drilling, for at present the limit in progress appears to be the time necessary for the removal of rock. Till some improvement has been made in this particular, further improvements, to secure greater speed in drilling, will effect little practical benefit.

With reference to the comparative advantage of the use of a powerful explosive and deep cuts, Mowbray states, in his work on tri-nitro-glycerine, that, while visiting the St. Gothard tunnel in 1873, he spoke of the obvious advantages of the method of blasting by cuts as then pursued at Hoosac, over the plan adopted in the workings at the Goeschenen end of the St. Gothard tunnel, where they were driving (in compact granite) first a heading 7 ft. high by 6 ft. 6 in. wide, and then enlargements of this heading on the left and right, whereas by cuts and squaring the whole heading could undoubtedly be more easily cleared at once, for not only does the method give more room and play to the machines, rendering them more easily handled, but in a small, narrow heading they cannot be set at such an angle as to ensure the best work.

M. Le Favre, the contractor, seemed, however, to consider the statement of Mr. Mowbray, that at Hoosac they were bringing out 8 and 10 lineal feet of rock at a shot, as—well, as an Americanism, and observed, "*Si vous pouvez entreprendre le forage, le chargement, et l'allumage de trous de trois metres, et manipuler le nitro-glycerine sans accident, naturellement nous sommes a vos pieds. Mais nous pensons que nous devons instruire les Americains, au lieu d'etre instruit de l'Ouest.*" Now, if M. Le Favre still holds these opinions, he should, ere this, have been "aux pieds de l'Ouest," for first at Hoosac, in hard granite, have holes of three metres been repeatedly and, as a rule, successfully taken out, and now, at Musconetcong, in harder syenite, the average advance per cut has been as above stated, 10 feet, and frequently, we can assure M. Le Favre, not only three but four metres have been attained at a blast. Mr. Mowbray, in arguing this method of blasting in preference to the European plan, of course based it on the necessity of using pure nitro-glycerine for cuts, or possibly "Mombray's Tri-nitro-glycerine," inasmuch as he states that M. Le Favre was at the time using both Krebs' lithofracteur and Nobel's dynamite, and with neither was able to blast out holes deeper than forty inches. Mr. Mowbray appears to ignore the fact that it was rather the small width of M. Le Favre's heading, than the use of dynamite that prevented deep shots, for inasmuch as Mr. Mowbray tells us that the Goeschenen heading was driven only 6 ft. 6 in. wide, he certainly must be aware that it would be somewhat difficult in a heading 6½ ft. wide to put in two sets of holes 9 feet apart, as are necessary for cuts; and that if even pure nitro-glycerine were used in a tight 6½-foot heading, it is very dubious whether it could be made to bring more than 3 to 4 feet at a shot. A careful perusal of Mr. Mowbray's opinions on high explosives would lead one to judge, not that he loved dynamite (mica-powder?) less, but tri-nitro-glycerine more, and possibly that his love has a little clouded his discernment. To entirely set Mr. Mowbray's mind at ease on the subject of the strength of dynamite, we would refer him to the above record of what it has done at Musconetcong, inasmuch as it is claimed that at Musconetcong the latest and best appliances have been put in force to expedite the work, and certainly the work done by dynamite has fully equalled, and rather excelled, the record of nitro-glycerine at Hoosac.

It is worth noting what this new explosive, giant-powder or dynamite, is. As to its characteristics—first it is tremendously powerful, bringing out at a blast masses of rock that black powder could not even shake, and is simply invaluable for rapid driving in hard rock. How it compares economically with pure nitro-glycerine we are not prepared to state. Containing a percentage of the latter, it is, of course, not so powerful bulk for bulk, but again it has the great advantage of distributing the force over a greater space, which is the underlying principle of much of the deep hole blasting. Again, so far as an explosive can be termed so, it is entirely safe from accident from the proverbial carelessness of workmen, undoubtedly safer by far than black powder, while many times stronger. Hardly anything short of a cap exploded in a cartridge will fire it. Alone, it may be hammered, crushed, or burnt with impunity. Thrown into a stove or set on fire, it simply burns fiercely without danger of explosion. For exploding the cartridges, very strong caps of fulminate of mercury are used; those adopted at Musconetcong, we believe, were originally imported from Hamburg. These caps are prepared as electric exploders, as follows: First, a small quantity of sensitive powder is dropped on the fulminate, and into this two wires (lying side by side) are inserted, and the caps then filled with melted sulphur. On the spark passing, the sensitive powder is ignited and explodes the fulminate, and the cap being inserted by the blaster into the cartridge of dynamite, the explosion of the cap fires the latter. If firing by fuse, it is simply necessary for the blaster to squeeze the end of a piece of fuse, properly rasped and sharpened, into the cap, and to place the latter in the cartridge. A good electric battery is that manufactured by the Laflin & Rand Company, under, we believe, Julius Smith's patent, the condenser and generating plate being of vulcanite, and the parts of the battery so arranged as to render it compact and easily handled.

Dynamite is simply nitro-glycerine mixed with a kind of silicious earth known variously as silicious marl, tripoli, and rotten stone. The peculiar variety of this material best suited for this use is homogeneous, has a low specific gravity, and is generally composed of the remains of infusoria. So great is the absorbent capacity of this earth that when in a pulverized condition, it is claimed by Nobel that it will take up about three times its own weight of liquid nitro-glycerine, and still retain the form of a powder. Any mineral, or indeed vegetable, substance susceptible of pulverization or comminution, and which will retain nitro-glycerine by absorption, may be substituted for infusorial earth in the manufacture of dynamite, but the latter has so far been found to excel all other substances tried in possessing the requirements necessary; being composed of minute tubular shells, it is light and absorbent. A mass of it is very spongy and compressible, its shells absorbing the nitro-glycerine by capillary action, and holding it with almost absolute security against filtration or compression. The secret of the safety of this powder seems to be in its soft, pulpy, and at the same time mealy consistency, which gives it a complete cushion to prevent percussion, as a blow upon it seems like a blow upon a bag of meal; the greater the quantity the more the compressibility, and the greater the safety.

In an admirable paper on dynamite, read by Captain Alex. Mackenzie, of the Corps of Engineers, before the Essayons Club, in February, 1874, he gives his experience of a visit to the works of the company in Morris County, N. J. He says: "The infusorial earth or kieselguhr was originally all imported from Germany, but beds of it were subsequently found in the vicinity of the works, in New Jersey. No. 1 powder is composed of 75 per cent. nitro-glycerine and 25 per cent. infusorial earth, made into cartridges 1⅛ in. diameter by 8 inches long. No. 2, of 36 per cent. nitro-glycerine, 43 per cent. nitrate of potash, 7 per cent. rosin, 7 per cent. sulphur, and 7 per cent. infusorial earth, comes in cartridges 1¼ inches in diameter by 8 inches long. The size of these cartridges may be varied to order. In manufacturing No. 1 powder, the kicselguhr is prepared for use by first mixing it with a little water and baking into bricks for thorough drying. These bricks are then ground and mixed with nitro-glycerine. In preparing the absorbent or dope for No. 2, the sulphur is pulverized in a revolving-cylinder, at one end of which a blast of air enters, and, passing through, carries the powdered sulphur into a tight box. The nitrate, either of soda or potassa, is first dried thoroughly on an iron floor, then ground in a mill and passed into a box. The rosin is pulverized in a cylinder. The sulphur, nitre, rosin and earth are then mixed in proper proportions. In making the nitro-glycerine, the following proportions are used: Two parts of sulphuric acid are mixed with one part of nitric acid. For every seven parts of the mixed acids one part of glycerine is added. One part of nitro-glycerine is expected for every four parts of the mixed acids. The relative strength of No. 1 and 2 powder has not yet been definitely determined practically by any series of experiments, but it may be calculated as follows:

No.	Composition.	Relative strength of components.	Relative strength as compared with pure nitro-glycerine.
1	75 per cent. nitro-glycerine. 25 per cent. kieselguhr.	75 per cent. 0 "	75 per cent.
2	36 per cent. nitro-glycerine. 64 per cent. potash, sulphur, etc.	36 per cent. 32 "	68 per cent.

"It is claimed that, though the absorbent of No. 2 has really but little strength within itself, it develops when fired by nitro-glycerine, about one-half the strength of nitro-glycerine pure.'

With reference to the direct connection of this explosive with tunnel work, the advantage gained by its use is based especially on the great saving of time, which is an object in all work. Taken pound for pound, it is more costly than black powder; but it should be remembered that its explosive force is also many times as great. Berthelot, in his researches on explosive matters, calculates from the chemical composition of the explosive the volume of the gases produced by the explosion, and the quantity of heat produced in the reaction. The product of the two numbers, as he conceives, giving within certain limits the explosive force, Berthelot's estimate gives the ratio of ordinary blasting powder to pure nitro-glycerine, as 88 to 939, or that nitro-glycerine is 10.7 times stronger, taken in equal weights. This estimate, applied to dynamite, would make No. 1 eight (8) times stronger than blasting powder, and, if we accept the estimate of 68 per cent. as the relative strength of No. 2, it would make No. 2 seven and three-tenths (7 3-10) stronger than blasting powder. The questions to be considered, in reference to the adoption of dynamite, would of course be governed by considerations of time, location of work, character of rock, etc. Where the material is a soft, dry rock, which can be attacked from several points at once, and in cases where the speedy completion of the work is not the most important element to be considered, probably black powder, at present prices, would be the cheaper agent; but, again, taking the case of a tunnel where the blasting, like that at Musconetcong, is for the greater part through hard, wet rock, which can only be attacked from two headings at a time, and where a heavy outlay of capital lies dead until the completion of the work, the advantage of using so speedy, and yet so safe, an agent is most manifest.

The introduction of dynamite has already revolutionized rock tunnelling, and, hand in hand with machine drilling, is doubling and trebling the old rates of progress attained by hand drilling and black powder.

Now, before taking up the east heading, we will consider in a few words the enlargement in rock of west heading No. 1. This "bench," as the rock enlargement is termed, was kept both on the east and west sides from four to six hundred feet back of the headings, so avoiding any interruptions at the bench from heading blasts, and allowing plenty of room for handling and switching cars, also for backing the machines to a safe distance from the face when blasting, etc. In taking up the west bench, there was no extraordinary detention; the work was begun about January 1, 1874. By table No 7 it will be seen that, owing to various detentions, its steady advance did not commence until July, 1874. Up to that time, though the headings were of course free from water, the flow remained so great that frequently the enlargement, on the shortest stoppage of the pumps, would become flooded several feet in depth; also, until the headings met, in December, 1874, both the west and east enlargements were detained by the time lost in removing the broken rock from the headings. This was run out from the top heading on a movable bridge extending over the men at the bench, and ending in a shute, into which the cars were dumped. From this shute the rock was again loaded on cars in the bottom and run out to the slope. Every time, therefore, that a blast was fired this bridge had to be run back, and then up again to the face as soon as the track could be cleared, much time being often lost in the operation from unavoidable detentions that frequently arose. The different rates of progress attained in running a bench with a heading in front, and after the headings are cleared, is shown in tables 7 and 9, by which it will be seen, the average monthly advance was raised in the west enlargement from 87 feet, in 1874, to 188 feet, in 1875, on the meeting of the headings in December, 1874; the increase in the east enlargement being from 96 feet, in 1874, to 181 feet, in 1875.

Figs. 9 and 10 show the method of blasting adopted in enlarging in rock. First, six top holes, from 12 to 13 feet deep, are drilled and blasted; their relative position is shown in Fig. 10, which is a horizontal projection of the heading, A being center line, B the sides in the enlargement, (B^1) sides of heading, C face of bench, and 1, 2, 3, 4, 5, 6, the holes. These six lift most of the rock; what is left is broken by several horizontal holes projected by (6) in Fig. 9, in which 1, 2 and 3 are the top carriage, drill, and location of hole; and 4, 5 and 6 the bottom carriage, etc.

These two sets of holes, top and bottom, will average a lineal advance for the bench of 9 feet, the following being a fair estimate for that advance of the number of feet drilled and powder burnt.

	No. of Holes.	Depth of Holes.	Total Depth of Holes.	Lb. No. 2 Dynamite.
Top holes	6	12 ft.	72 ft.	62 lb.
Bottom holes	4	10 "	40 "	45 "
Totals	10		112 ft.	107 lb.

The total height of the cross-section adopted for the tunnel through rock (Fig. 2), from lower sub-grade (1.75 ft. below base of rail) to roof, was 20.15 feet; with an 8-foot heading off, this leaves about 12 feet of a bench, with an area of 306 square feet, which gives about 102 cubic yards to a lineal advance of 9 feet, or 1.05 pounds No. 2 dynamite, and 1.1 foot of holes drilled to one cubic yard of rock broken, holes being drilled with from 1¼ to 2¾-inch bits, the largest bits being put in first. In general, three machines are kept in use at the bench, two on top and one below; to run them, 3 drillers and 3 helpers are needed, about 14 laborers to clear away rock, one nipper, and a boss.

Before speaking of the east end, it may be well to state that the enlargement in rock of No. 2, or the heading driven west from the slope, was not pushed during the foregoing work, there not being the same necessity for haste. Table 8 will show its progress. After passing the junction of headings Nos. 2 and 3, it was driven on to a point about 175 feet from the slope. There the rock giving out, the enlargement in earth, to be followed by arching, commenced, which will be described hereafter.

THE EAST HEADING

had no serious natural detention from its beginning to end. Its monthly progress is shown by Table 6. The open cut was sufficiently advanced by July 22, 1872, for the top heading to be commenced. It was started in a very loose, decomposed syenite, and driven for the first 60 feet of the size of, and timbered in the same manner as, the small earth heading at the west end, this small heading being subsequently taken out in open cut. At that point, meeting solid rock, the heading was enlarged to the full width of 26 feet, and driven on by hand labor until the machines were introduced in January, 1873. Giant powder and Ingersoll drills were used as at the west end, and cut blasting was begun in November, 1873, making at once a marked difference in the rate of progress, as the men became more familar with it, raising the progress from the previous average of 89 feet per month in 1873 to 116 feet in 1874. The compressors were of the Rand & Waring make, and were located about 300 feet from the mouth of the tunnel, giving the air about 2,800 feet to travel, at most, by the time the headings met. Four of them were in constant use, three of 12-inch and one 16-inch air cylinder. These compressors consist of a horizontal air cylinder, driven by an oscillating steam cylinder.

There is no illustration offered of them, simply because the author had not time to get one up in addition to the other drawings, and for those who are unfamiliar with the working of air-compressors, the section of the Burleigh will sufficiently show the principle. The section seen in Fig. 5, of the Burleigh compressor, is adapted from one given in the *Revue Universelle des Mines* for July and August, 1874, with some slight modifications in internal structure.

Steam for running the compressors was supplied by five large locomotive boilers of 50 h. p. each, and all the coal and machinery used at this end of the tunnel had to be carted, it will be noted, some five miles over a heavy mountain road, from the New Jersey Central depot on the west side. The only two serious interruptions to progress that occurred at the east end were, first, in September, 1872, a riot between the Irish and colored workmen that Mr. McFadden had imported from Alexandria, Va., in which three of the latter and one Irishmen were killed; the ultimate, and, in fact, very speedy result being a scarcity of negroes for some time in the vicinity; and, second, the explosion in April, 1874, of one of a new pair of boilers that had recently been put up, by which three men lost their lives. This accident stopped work, except some driving by hand labor, for nearly two weeks, until the damage could be in a measure repaired, and its effect was felt for some time.

Two accidents also occurred at this end, strikingly illustrative of the principles given above as governing the use of dynamite. Besides the regular magazine, it is advisable to keep a so-called dry-house in which the blasters prepare their charges for each round, and in which a fire is kept burning in Winter to thaw the powder, which congeals at a low temperature, thereby lessening its readiness to explosion. One day, there being three men in the room, one of them, becoming impatient, took two cartridges and held them to the fire to thaw more quickly. They took fire, when, instead of throwing them out of doors, in his confusion he dropped them into a box of cartridges ready *capped for a blast*. Those three men had no unseemly pride as to appearances—they went out of the windows or door as happened to come most convenient, and were only some fifty feet away when the fire reached the caps, and four boxes, or 200 lbs. of dynamite went up. There was nothing subsequently found of that excellent stove but the mutilated fragment of one hind leg. The boarding and frame-work of the house were reduced to native fibrine, and fell in a gentle rain. A clerk of Mr. McFadden's was posting up a ledger at a window facing the explosion, with his ink before him. The bottle, with a good part of the window was thereon carried in his face, and for some time his tattooing would have done credit to a South Sea Islander. The author had occasion to seek his noon sustenance at an adjoining house, and found the old woman in decided tribulation. All her windows were, of course, gone. Those of her neighbors were gone, too, however, so therein she had comfort; but her loss was felt, in that she had just nicely papered the cracks of her shanty for the winter, and the explosion cleaned out every bit of it. She was consoled somewhat by discovering on the floor several pairs of scissors which she had lost. They had been hid in cracks between the boarding, and the shock opened the latter and threw them out. "*Parturiunt montes*," etc.

Now, the above accident pointedly illustrates the fact of the safety of this powder until knowingly rendered explosive by the introduction of the caps. Suppose a man were to hold some black powder to a fire, and, on its igniting, drop it into a box of the same, is it very likely it would obligingly give him time to get out of danger, and then only blow up because the fire reached some caps designed to explode it?

A curious accident, also, fortunately a harmless one as to loss of life, occurred on another occasion with these caps. A box of them, containing several thousand, was lying in the upper room of the store building, and a hostler was sleeping in the same room. (It happened to be in winter, so he was well wrapped up.) His watch hung by the side of his bed, toward the box of caps. In the middle of the night, that box exploded from some undetermined cause. The sides of the house and roof adjoining were torn off, the floor crushed in, but, strange to say, Flanagan was unhurt! He declared himself "considerably shook up," and regretted the loss of his watch, as only one side of the case was left, the works being completely blown out, and the case indented with the marks of one or two cartridges that had struck it. Now, it will be understood that the above incidents are quoted in all soberness, as incidental to the history of Musconetcong, and the occurrences are emphatically vouched for by the author as authentic.

[TO BE CONCLUDED NEXT WEEK.]

ANNUAL REPORTS.

Chicago, Milwaukee & St. Paul.

The report for the calendar year appears much earlier than usual.

The mileage of road owned and worked in 1874 was the same as in 1873, namely, 1,399 miles, including two distinct lines from Milwaukee to St. Paul (one by way of Prairie du Chien, 405 miles long, and the other by La Crosse, 324 miles), a line from Chicago to Milwaukee, 85 miles, eleven branches of these lines, and one line which is an extension of the Western Union Railroad, controlled by the Chicago, Milwaukee & St. Paul.

The equipment owned by the company is as follows:

Locomotives		203
Passenger train cars:		
First-class	64	
Second-class	31	
Sleeping	11	
Baggage, mail and express	57	
	—	163
Freight train cars:		
Box and caboose	2,995	
Flat and coal	665	
	—	3,660
Boarding cars		2

This equipment was increased during the year by the addition of five locomotives, 2 baggage cars and 23 box cars, costing nearly $112,000.

Other property owned by the company includes $2,001,000 (more than half) of the stock of the Western Union Railroad Company, which is inventoried in the capital account at 75 per cent. of its face, about $130,000 of Madison & Portage, $24,000 of city bonds, and $15,000 of St. Paul, Stillwater & Taylor's Falls stock.

The credit side of the capital account shows:

Preferred stock	$12,274,483	
Common stock	15,399,261	
		$27,673,744
First-mortgage 7 per cent. bonds (8 issues)		19,503,000
First-mortgage 8 per cent. bonds		4,455,500
Second-mortgage 7 per cent. bonds		1,191,000
Second-mortgage 7.3 per cent. bonds		1,315,000
Other 7 per cent. bonds		410,110
Equipment and bridge 10 per cent. bonds		245,000
		$27,119,610

A floating debt of about $1,800,000 is reported, against which is set off $2,000,000 of dues, materials on hand, and cash.

During the year there was an increase of $838,000 in the bonded debt, owing to the issue of that amount of consolidated bonds in payment of the dividend on preferred stock. There was no increase in stock. The interest on the bonds was $1,839,643 in 1873 and $1,951,162 in 1874, showing an increase of $111,519, and the interest charge per mile last year was $1,395. The amount of stock is $19,781 per mile; of bonds, $19,385.

The work done was:

Train Mileage:—	1874.	1873.	Inc. or Dec.	P. c.
Passenger trains	1,194,310	1,352,256	Dec. 157,946	11.7
Freight trains	3,505,561	3,376,299	Inc. 129,262	3.8
Service trains	344,310	477,333	Dec. 133,023	28.0
Total	5,044,181	5,205,888	Dec. 161,707	3.1
Tonnage mileage	259,168,248	257,638,532	Inc. 1,529,716	6.0
Passenger mileage	58,260,429	52,252,558	Inc. 6,007,871	11.5

The earnings from this work were:

	1874.	1873.	Inc. or Dec.	P. c.
Freight	$6,137,151 84	$6,421,369 24	Dec. $284,217 40	4.4
Passenger	1,933,664 98	1,857,196 43	Inc. 76,468 55	4.1
Mails, express, etc	882,200 29	767,557 90	Inc. 114,642 39	14.9
Total	$8,953,017 11	$9,046,123 57	Dec. $93,106 46	1.3
Working expenses	5,871,116 38	6,594,560 33	Dec. 723,443 95	10.9
Net earnings	$3,081,900 73	$2,451,563 24	Inc. $630,337 49	25.7

The chief decrease in expenditures is in those classed as "extraordinary" in which nearly $800,000 less than in 1873 is charged to renewal of track.

The following is a summary of the results of the year for each division and the road as a whole:

	Chicago & Milwaukee.	La Crosse.	River.	Prairie du Chien.	Iowa & Minn. and Iowa & Dakota.	Northern.	Hastings & Dakota.	Illinois & Iowa.	All Divisions.
Miles run by passenger trains	195,670	287,950	162,456	213,914	220,887	98,064	14,069	18,500	1,194,310
* Miles run by freight trains	383,193	1,009,271	218,167	833,874	699,911	283,425	41,637	56,083	3,505,561
† Miles run by wood and gravel trains	36,000	85,460	30,550	66,960	64,945	40,720	11,700	7,975	344,310
Total miles run	614,863	1,373,681	411,173	1,114,748	985,543	399,209	67,406	77,558	5,044,181
Tons freight carried one mile	32,440,549	71,743,798	20,721,913	73,494,603	40,957,696	7,045,442	915,491	2,127,756	259,168,248
Passengers carried one mile	10,916,795	16,736,773	8,346,267	8,898,804	8,430,018	4,408,150	350,989	242,654	58,260,429
Earnings per mile run on freight	$1 66	$1 88	$1 90	$2 24	$1 48	$1 87	$0 84	$1 14	$1 75
Earnings per mile run on passengers	1 66	1 79	1 67	1 44	1 64	1 51	1 17	0 70	1 62
Expenses per mile run, including all expenditures	$1 33	$1 17	$1 13	$1 42	$1 17	$1 46	$1 20	$0 90	$1 25
Percentage of expenses to earnings, including all expenditures	64 per cent.	66 per cent.	58 per cent.	61 per cent.	73 per cent.	72 per cent.	108 per ct.	80 per cent.	66 per cent.
Amount received per ton per mile	.01 96-100	.02 95-100	.02	.02 54-100	.01 53-100	.02 92-100	.03 80-100	.03	.02 38-100
Amount received per passenger per mile	.02 96-100	.03 05-100	.03 24-100	.03 48-100	.04 30-100	.03 36-100	.04 69-100	.03 89-100	.03 35-100
Length of road December 31, 1874	85 miles.	233 miles.	128 miles.	235 miles.	397 miles.	159 miles.	75 miles.	87 miles.	1,399 miles.
Gross earnings per mile of road	$13,114 71	$9,875 06	$5,790 97	$10,457 15	$3,701 11	$4,586 00	$824 38	$900 70	$6,399 58
Net earnings per mile of road	4,713 64	3,394 76	2,434 65	4,116 17	990 88	1,302 15		180 50	2,202 93

* Includes switching.
† Wood and gravel trains are not included in the above percentages.

ELECTIONS AND APPOINTMENTS.

Michigan Central.—From June 1 the ticket and passenger departments are under the charge of Mr. Henry C. Wentworth, as General Passenger and Ticket Agent, with headquarters at Chicago. The reports heretofore addressed to Mr. C. D. Whitcomb, General Ticket Agent, will be sent to Mr. Wentworth at Detroit. General correspondence should be addressed to him in Chicago.

Pacific Mail Steamship Company.—The new board has re-elected Sidney Dillon President and George S. Scott, Vice-President.

Green Mountain Narrow-Gauge.—This company was organized at a meeting held in Bellows Falls, Vt., recently, by the election of the following officers: President, John Sprague, Conway, Mass.; Secretary, D. C. Hackett, Ludlow, Vt.; Treasurer, C. W. Sprague, Weston, Vt.

Pittsburgh & Lake Erie.—The first board of directors of this new company is as follows: John Bissell, John F. Dravo, P. W. Keller, Wm. McCreery, A. J. McKinley, George C. Reis, Joshua Rhodes, Wm. M. Short, James Westerman.

Atchison, Topeka & Santa Fe.—At the annual meeting in Topeka, Kan., May 27, the following directors were chosen: C. K. Halliday, D. L. Lakin, T. J. Peter, Topeka, Kan.; George Opdyke, New York; Ginery Twichell, Brookline, Mass.; J. T. Burr, B. P. Cheney, Thomas Nickerson, Joseph Nickerson, F. H. Peabody, Alden Speare, Thomas Upham, George B. Wilbur, Boston. The Board elected Thomas Nickerson, President; F. H. Peabody, Vice-President; W. Pierce, Secretary and Treasurer; C. T. Morse, Superintendent; A. S. Johnson, Acting Land Commissioner.

St. Paul, Stillwater & Taylor's Falls.—At the annual meeting in St. Paul, Minn., May 26, the following directors were chosen: M. Auerbach, Peter Berkey, A. H. Baldwin, R. Blakely, Wm. Crooks, Wm. B. Dean, E. F. Drake, R. F. Hersey, John W. Merriam, Isaac Staples, A. B. Stickney, Horace Thompson, A. H. Wilder.

Wisconsin Central.—At the annual meeting, May 27, the following directors were chosen: Matthew Wadleigh, Stevens Point, Wis.; H. L. Palmer, Milwaukee; Samuel Gould, Boston. The directors then elected the following officers: President, Gardner Colby; Vice-President, Charles L. Colby; Secretary and Treasurer, E. H. Abbott.

Texas Western.—Major Goodwin has been appointed Superintendent and Chief Engineer, in place of Mr. J. M. Mitchell, resigned. He is well known in Texas as an extensive bridge contractor.

Northern, of New Hampshire.—At the thirtieth annual meeting in Concord, N. H., May 27, the old board of directors was re-elected, as follows: George W. Nesmith, Franklin, N. H.; Josiah Minot, Onslow Stearns, Concord, N. H.; John A. Burnham, Charles F. Choate, Uriel Crocker, Edward Lawrence, Boston.

Nashua & Rochester.—At the annual meeting in Nashua, N. H., May 27, the following directors were chosen: Francis H. Kinnicutt, C. H. Waters, N. V. Whitehouse, J. C. Eastman, Francis H. Dewey, Charles E. Whitin, E. B. Stoddard, Charles W. Smith, Charles S. Turner, Aaron W. Sawyer, A. H. Dunlap, John Lynch, Joseph C. Burley, George H. Whitney and Edwin Wallace. Mr. Francis H. Kinnicutt was chosen President, and Gen. Aaron F. Stevens, Clerk.

Suncook Valley.—At the annual meeting in Manchester, N. H., May 27, the old board was re-elected, as follows: Gen. Natt. Head, Hooksett, N. H.; Lemuel B. Towle, Epsom, N. H.; Charles H. Carpenter, Chichester, N. H.; Reuben L. French, Pittsfield, N. H.; Samuel N. Bell, Fred. K. Smythe, Martin V. B. Edgerly, Manchester, N. H. The board re-elected Samuel N. Bell, President; Lewis W. Clark, Clerk; George Harrington, Treasurer.

Junction & Breakwater.—Mr. N. L. McCready has been chosen President in place of Mr. Reed, resigned. He is connected with the Old Dominion Steamship Company.

Mr. Adolphus Brown has been appointed General Freight and Passenger Agent of this road and also of the Breakwater & Frankford and the Worcester Railroads. His office is at Lewes, Del.

Camden & Atlantic.—Mr. F. A. Lister, heretofore Assistant Superintendent, has been appointed Superintendent, to date from June 1.

Lafayette, La Salle & Clinton.—At the annual meeting in La Salle, Ill., recently, A. Campbell, S. B. French, Elmer Baldwin and Theron D. Brewster were chosen directors, being one-third of the board. The board elected the following officers: President, E. H. Thayer, Clinton; Vice-President, S. B. French, Malden; Secretary, Daniel Evans, La Salle, Ill.; Treasurer, T. D. Brewster, Peru, Ill. The Executive Committee are S. B. French, Elmer Baldwin, A. Campbell, W. L. Hues and E. H. Thayer.

Louisiana Pacific.—This company has been organized in New Orleans by the election of the following directors: H. Kennedy, Emory Clapp, John Phelps, John H. Kennard, Cyrus Bussy, Louis Schneider, George Jones, W. B. Schmidt, James Gardner, Julius Weis, E. L. Ranlett, David Wallace, E. B. Wheelock.

Frankfort, Muncie & Bloomington.—The officers of this newly organized company are: Isaac N. Davis, President; George W. Goodwin, Vice-President; S. O. Bayless, Secretary; S. H. Doyal, Treasurer.

Chicago & South Atlantic.—The first board of directors is as follows: Frank Bower, J. Cavendish Robinson, Thomas J. Roe, Chicago; Lycurgus Dalton, John H. Piercy, Will A. Peelle, Jr., William O. Foley, Indianapolis.

Western, of Alabama.—Gen. E. P. Alexander is to be General Manager of this road for the Georgia and the Central companies.

Burlington, Cedar Rapids & Minnesota.—Mr. W. W. Walker, Superintendent of the road, has been appointed Receiver, on application of the bondholders.

Baltimore, Philadelphia & New York.—Mr. Robert Frazer, President of the Wilmington & Reading, has been chosen President of this company, with which the Wilmington & Reading is now consolidated.

Pennsylvania Company.—Ex-Senator John Scott has been appointed solicitor, and will have his office in Pittsburgh. He will act generally as legal adviser to the company, but the trial and pleading of cases in court will continue to be conducted by the present attorneys of the company.

Central Vermont.—The board has elected J. Gregory Smith, President; James R. Langdon, First Vice Presipent; W. C. Smith, Second Vice President; J. G. Smith, J. Q. Hoyt, J. H. Kimball, J. R. Langdon and W. C. Rmith, Executive Committee; J. R. Langdon, Jacob Edwards, Geo. M. Rice, J. H. Kimball and H. P. Cheney, Finance Committee.

The opposition board, which also claims to be elected, is as follows: R. H. Hoyt, Bradley Barlow, St. Albans, Vt.; John B. Page, Rutland, Vt.; J. W. Hickok, Burlington, Vt.; J. R. Langdon, Montpelier, Vt.; J. H. Williams, Bellows Falls, Vt.; Jacob Estey, Brattleboro, Vt.; George M. Rice, Worcester, Mass.; E. H. Mandell, New Bedford, Mass.; F. A. Brooks, J. S. Whitney, Jacob Edwards, Wm. Sohier, Boston. Messrs. Page, Langdon, Estey, Edwards and Rice are on both boards.

RAILROAD GAZETTE

Published Every Saturday.

CONDUCTED BY

S. WRIGHT DUNNING AND M. N. FORNEY.

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Editorial Announcements.

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particulars as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

THE CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

This company ranks easily with the greatest railroad corporations of the world. The 1,399 miles of railroad which it works it owns wholly, and it has a controlling interest in another line 213 miles long. Although it is not without competitors for much of the traffic of the country through which its lines run, it is the great dependence of the city of Milwaukee both for bringing in produce and for distributing merchandise. It is the chief carrier of a very large part of Minnesota as well as Wisconsin, of no inconsiderable part of Northern Iowa, and works also to some extent in Illinois. Its system is pretty compact, concentrating on Milwaukee, with an outlet thence to Chicago to connect it with the railroads to the East. Its original purpose was and its chief value still is as a carrier to and from Lake Michigan. More than most Western railroads even its traffic depends upon agriculture. There is no coal on its lines, and few of the great and heavy manufactures that depend on cheap coal for their success. And the agricultural produce of the country which it serves is singularly uniform—at least the exported produce is—consisting mainly of wheat. It carries little corn, and few cattle and hogs, but it reaches what are probably the best spring wheat lands in the country, producing large crops with a regularity and certainty hardly known anywhere further south. It also penetrates some of the most productive lumber districts, which for the most part give a traffic in a direction opposite to that in which the wheat moves.

One of the results of this simplicity of traffic is that the prosperity of the country, and of the road with it, depends largely on the amount of production and the price of a single crop. If wheat is plenty and high, the road has a heavy traffic in both directions and makes large profits; if the crop is very poor and the prices very low, the country suffers and the railroad with it.

The wheat crop of the year 1873 in the country served by this railroad, which gave the chief traffic of the road for the first eight months of the year 1874, was an unusually large one, and the price paid for it was unusually high. That of 1874, which has afforded the traffic since, was perhaps equally large, but it has brought an extremely low price, and has come forward very slowly. Thus, so far as this great staple is concerned, the traffic of the road should have been good two-thirds of the year and bad for the other third. General business, however, was dull in Wisconsin and vicinity throughout 1874, as it was in the rest of the country, so that it cannot by any means be called a favorable year. The company, like most others in the Northwest, had not long before made great additions to its lines, doubtless counting on a continuance of the prosperity of the country, which then seemed likely to afford business for every new enterprise. It had brought its work of extension to a close, however, and the length of its lines was 1,399 miles both in 1873 and 1874.

The results of the year's working, compared with those of 1873, may be briefly stated as follows: An increase of 6 per cent. in freight traffic and an increase of 11½ per cent. in passenger traffic—equivalent to an increase of about 2½ per cent. in total traffic. The freight traffic, which was thus 6 per cent. larger, was carried with an increase of less than 4 per cent. in freight-train mileage, and there was a decrease of more than 11½ per cent. in passenger-train mileage in spite of the increase of 11½ per cent. in passenger traffic; and in total train mileage there was a decrease of 3 per cent., notwithstanding the average addition of 2½ per cent. to the total traffic. The earnings were less by 1½ per cent., but the working expenses were meanwhile reduced nearly 11 per cent., and the result was an increase in net earnings of 25.7 per cent.

The General Manager's report gives earnings, expenses and traffic by divisions, so that we are able to tell which parts of the road have done best and worst. Judging by net earnings per mile, the newest part of the road—the Chicago & Milwaukee Division is by far the most valuable, having net earnings of $4,714 per mile, which is nearly 15 per cent. more than those of the next most profitable division (the Prairie du Chien), and 115 per cent. greater than the average net profits per mile of the company's lines. Another new line, the "River Division," has $2,435 net earnings per mile, while the average is $2,203; but the new "Illinois & Iowa Division" (Sabula, Ackley & Dakota Railroad) earned net per mile but $180.50; the Iowa & Minnesota and Iowa & Dakota divisions, a part of which is new, and which are reported together, yielded only $991 per mile, and the Hastings & Dakota exhibited a net loss of $66 per mile.

A statement of these net earnings per division for the year is as follows, in which the first named are the older and the last the newer divisions, the division being on the Iowa & Minnesota and Iowa & Dakota divisions, which include a great deal of old and a great deal of new road:

Divisions.	Net earnings. 1874.
LaCrosse	$790,980
Prairie du Chien	967,300
Northern	207,042
Iowa & Minnesota and Iowa & Dakota	393,381
Chicago & Milwaukee	400,660
River	311,636
Illinois & Iowa	15,703
Hastings & Dakota, loss	4,800

Leaving out the Iowa & Minnesota and Iowa & Dakota, as being both new and old, and adding those above and below it separately, we have:

627 miles of old road earned net $1,965,322, which is... $3,135 per mile
375 miles of old road earned net $728,000, which is.... 1,941 " "

The old road here is seen to be much more profitable than the new, yet the latter's net earnings exceed by $546 per mile, or nearly 40 per cent., the average interest charge, so that they would seem to be, on the average, profitable, unless indeed an undue proportion of the funded debt was incurred on their account, so that the average interest charge per mile does not equal that which their acquirement has imposed upon the company. Only two of the new lines, it appears, earn as much as 7 per cent. interest on $20,000 of bonds per mile, but one of these earns that interest on $67,000 and the other on $34,800, and all make on the average 7 per cent. on $27,700 per mile. If the new lines in the Iowa & Minnesota and Iowa & Dakota divisions were reported separately, they would doubtless have to be classed with the unprofitable lines and would bring down the average of the profits of the new lines per mile. Indeed, old and new together they make a profit of but $991 per mile, which is exhausted in paying 7 per cent. interest on a little more than $14,000.

As this company has but recently got a Chicago outlet of its own, and as there is considerable rivalry between its old sole terminus at Milwaukee and this new second one further down the lake, it will be interesting to note how these two great lake termini compare with each other in their traffic and earnings. The elaborate tables of the report, giving the number of passengers and tons of freight, and the receipts therefrom, received and forwarded at every station on the road, enable us to do this.

From this we learn that the number passengers and tons of freight arriving at and departing from these cities by this company's road, and the receipts therefrom, were:

MILWAUKEE.

Passengers:—	Number.	Revenue.
Arriving	135,045	$228,413 18
Departing	139,227	248,568 99
Total	274,272	$476,982 17
Freight:—	Tons.	Revenue.
Forwarded	283,033	$757,249 14
Received	681,309	2,762,383 77
Total	964,342	$3,519,632 91
Total freight and passenger revenue		$3,996,614 08

CHICAGO.

Passengers:—	Number.	Revenue.
Arriving	69,148	$307,024 98
Departing	78,768	352,696 11
Total	147,916	$659,721 09
Freight:—	Tons.	Revenue.
Forwarded	124,317	$646,650 73
Received	272,213	854,426 29
Total	396,530	$1,501,077 02
Total passenger and freight revenue		$2,160,798 11

This shows the passenger traffic at Chicago to be 55 per cent. of that at Milwaukee, but the receipts from it to be about 40 per cent. greater, it having nearly six times as many through passengers. In freight, the Chicago movement is 41 per cent. of the Milwaukee movement, and the earnings are but three-sevenths as much, or 43 per cent.

It is not in the nature of things that the bulk of the Chicago, Milwaukee & St. Paul traffic should be transferred from Milwaukee. The latter city is the point of concentration of all the companies' lines, and it has something like 500 miles of road within a hundred miles of it. On the other hand, the 85 miles of the Chicago & Milwaukee Division forms all the road built for the purpose of reaching Chicago, all from which Chicago can be reached without passing through Milwaukee, and half of it, of course, is nearer to Milwaukee than to Chicago. This position secures to Milwaukee an enormous preponderance of way travel, of which it had twice as much as Chicago in 1874, while of way freight it had not much less than three times as much. In through freights, as well as passengers, Chicago surpassed Milwaukee. It could never have reasonably been expected that Chicago should draw the wheat traffic from Milwaukee, at least so long as the quality of Milwaukee spring wheat ranks so much above the Chicago grades, but the real competition is with the merchants who sell goods to the interior supplied over this company's lines. Now we see that the number of tons forwarded from Chicago is 44 per cent. of the number forwarded from Milwaukee, while the tons received are but 40 per cent. Proportionally, then, it seems that Chicago has made greater progress in selling goods to the country served by the Chicago, Milwaukee & St. Paul Railway than it has in buying its produce. In both, however, it has made sufficient progress to justify the addition of its name to the other old title of the company—Milwaukee & St. Paul.

In the little table below we make some comparisons which show the progress of the road during the year quite clearly, the statements being made per mile of road or other unit, so as to reduce the figures to dimensions easily comprehended:

	1874.	1873.
Stock and bonds per mile	$38,080	$37,480
Gross earnings per mile	6,400	6,536
Net earnings per mile	2,203	1,752
Interest charge per mile	1,395	1,315
Divisible surplus per mile	808	437
Receipt per traffic train mile	$1.90	$1.91
Expense per train mile	1.25	1.39
Profit per train mile	0.65	0.52

This shows the interest charge per mile to have grown $80 during the year, against which we have to offset an increase of no less than $451 in net earnings, and so the surplus of net earnings above interest—the portion which in one form or another is at the disposal of the company—has increased from $437 to $808—about 85 per cent. This surplus was equivalent to 4 1-6 per cent. on the whole amount of stock or to more than 9 per cent. on the preferred stock. As we have noticed in several cases this year, the large savings in expenditures made in the face of an increased traffic find part of their reason in better train loads, more traffic being carried with fewer train miles. The largest part of this company's saving, however, is due to an immense reduction in the expenditures for renewals, which the previous year had been very large, and probably should, in part, have been charged to construction.

This company, like most others, shows a continuation of the downward progress in freight rates. There has been little interruption in this since 1865, when the average receipt per ton per mile was 4.11 cents, to 1874, when it was 2.38 cents—45 per cent. less. For ten years the figures are:

For 1865	4.11 cts.	For 1870	2.82 cts.
For 1866	3.76 cts.	For 1871	2.54 cts.
For 1867	3.94 cts.	For 1872	2.43 cts.
For 1868	3.49 cts.	For 1873	2.50 cts.
For 1869	3.10 cts.	For 1874	2.38 cts.

The reduction for the last year was 5 per cent. It was somewhat increased, doubtless, by the enforcement of the Potter law, but as that was in effect but three months of the year it did not have its full influence.

This company has an unusually small capital account, about half in bonds and half in stock, and with comparatively small earnings will be able to pay dividends. The interest charge is covered by $1,400 per mile, and net earnings above this amount are available for dividends, and with $10,000 gross receipts per mile, and last year's proportion of expenses, it would be able to make 10 per cent. dividends on all its stocks. This rate of earnings cannot be expected for some time to come, it is true, but it is not so large but that it may be attained after several years of growth and prosperity in the Northwest.

Rapid Transit.

The *Scientific American* in its issue of June 5 has fallen into the error of ascribing to us the opinions of a correspondent whose communication was published in the *Railroad Gazette* of May 15. As we are in no way responsible for the opinions which our correspondent holds we do not feel called upon to defend them. Our contemporary, however, expresses sorrow that we are "not better satisfied with the improvements that have been made,"

on the Greenwich Street Railroad, but as we never expressed dissatisfaction, this grief is perhaps uncalled for, unless the supposed mental obliquity of the author of the criticism of the road referred to should excite corresponding emotions of sympathy and mourning. It seems to us, however, that there is just ground for dissatisfaction on the part of the readers of the *Scientific American* in the nature of the criticism which it has aimed at us instead of our correspondent. He gave his reasons for thinking that the diagonal struts which have recently been added to the columns of the road structure referred to were an injury instead of a benefit, and stated that "it may be a wise economy in prolonging the life of the structure to entirely remove these struts." The reply of our contemporary to the reasons on which this conclusion is based is, that such fears "are in our view unnecessary," and that the company appears to have done the best it knew how under the the circumstances, "and all the patrons of the road are pleased with the improvements." Now it is not a question whether what was done was "the best the company knew," but whether what they have done is adequate for the purpose arrived at, which was greater safety and security for the passengers who travel over their road. The company are not only bound to do the best they know, but it is their duty to know the best thing that can be done. The dissatisfaction of our correspondent is at the fact that what they have done, and which our contemporary says is the best they knew, instead of increasing has diminished the security of the structure, and he gives his reasons, we think, quite clearly for this conclusion. The "scientific" method of dealing with such mistakes would be to show the error in his statement of facts or the fallacy of the reasoning based on them, and it certainly is a new way of demonstrating that an engineering structure is secure to say that the "patrons of the road are pleased with the improvements."

The real friends of rapid transit have watched the Greenwich Street road with very great solicitude ever since it has been in operation, as a serious accident on its line would doubtless have the effect of creating great distrust of elevated roads, which, we believe, afford the most practicable means for rapid transit in New York city. While the Greenwich Street road has been demonstrating the fact month by month, its operation, until quite recently, was attended with so much danger that those most competent to judge were unwilling to take the risk of traveling on it. Happily these latter have been very much lessened by some of the recent improvements, and if any just criticism will help to increase this security it will at the same time aid in providing New York city with adequate rapid transit.

It is from this motive, therefore, that we wish to call attention to what seems to us a defect in the manner in which the cross-ties are attached to the structure below them. These rest on wrought-iron longitudinal beams which extend from one post to the other. The cross-ties are bolted to these beams with small bolts which pass through the ties and are fastened to the beams with hook-head bolts. The objection to this method of construction is that in case a train should get off the track the fastening of the cross-ties is not strong enough to prevent them from being pushed together by the train. This is the danger which should always be guarded against on bridges on ordinary railroads. On the Elevated Railroad longitudinal timbers are placed inside of each rail to push engines or cars on the track in case the wheels should get off the rails. These timbers are bolted to the cross-ties. Now by simply notching the timbers and letting the cross-ties into the notches the ties would be securely held longitudinally so as to prevent a derailed train from pushing them together. If they can be held in their proper position, the wheels of a car or engine, although they should get off of the rails, would run a long distance without incurring serious danger, but if the ties are pushed together so as to leave sufficient space between them for the wheels to fall down below the ties, there is very great danger of serious disaster.

There is excellent reason to believe that if the bill which has recently been passed by the New York Legislature should become a law, granting to the Greenwich Street road some additional privileges, the west side of New York will in a few months' time have at least one efficient line of rapid transit road. If it is ever practically demonstrated that such a road can be operated successfully and profitably, the problem will then be solved, and the enterprise of existing companies can be relied upon with tolerable certainty to construct such lines as rapidly as the increase of population will require them. It is, however, very important that this pioneer road should incur as few risks and dangers as possible, and therefore we believe its managers as well as the public will welcome all fair criticism of the methods of construction.

Earnings and Expenses in 1874.

We have compiled and publish elsewhere a table of the earnings and expenses and net earnings of all railroads in the United States that have up to this time reported these figures for the years 1873 and 1874. The table gives the reports of 58 companies, with 17,684 miles of railroad, which is fully one-fourth of the mileage of the United States worked during the year, and is extensive enough to enable us to judge of the whole railroad system of the country for the past year.

Taking the whole mileage reporting, the facts shown are as follows:

	1874.	1873.	Inc. or Dec.	P. c.
Mileage	17,684	17,581	Inc., 103	0.6
Earnings	$173,708,410	$184,728,865	Dec., $11,020,455	6.0
Expenses	105,840,951	121,945,203	Dec., 16,104,252	13.2
Net earnings	67,867,459	62,783,662	Inc., 5,083,797	8.0

This gives in a nutshell the financial results of last year's working, so far as these roads are concerned, and they are so well distributed and form so large a part of the whole that we shall probably not greatly err if we extend the deduction to the whole railroad system of the country. This quarter of the United States mileage, it is seen, being but three-fifths of one per cent. larger than in 1873, earned eleven millions (6 per cent.) less; but its working expenses were reduced by no less than 13.2 per cent., or sixteen millions, so that there was in this, the panic year, a time of great prostration in many industries and an almost unprecedented arrest of growth, an actual increase of 8 per cent. in the net earnings of these roads, amounting to five millions of dollars. This is an almost incredibly favorable issue of a season of adversity. Of course it has been made possible only by a great reduction in the prices of labor and supplies; and, we may add, it has been attained in too many cases by an actual starving of roads and equipment, the average condition of which was not so good at the end as at the beginning of 1874, and in many cases very much worse.

Still the figures show that by hook or crook the increase in net earnings was made, and indicate that but for obligations entered into before the panic, chiefly for additions to their road and equipment, the railroads of this country would have been not only as a rule out of difficulty, but decidedly prosperous. Could we put a column of the annual interest on bonded debt by the side of net earnings, however, it would probably show that there had been an increase in this more than balancing the increase in net earnings.

The increase in mileage of these roads is so small that the proportions will not be greatly changed if we neglect its consideration. Below, however, is a table of earnings, expenses and net earnings per mile, which will show the progress exactly:

GENERAL AVERAGES.

	1874.	1873.	Increase.	Decrease.	P.c.
Earnings per mile	$9,823	$10,507	.....	$634	6.5
Expenses per mile	5,985	6,936	.....	951	13.7
Net earnings per mile	3,838	3,571	$267	.....	7.5
Per cent. of expenses	60.93	66.01	.....	5.03	7.7

The average earnings per mile of these roads in 1873 were greater by nearly one-third than the average per mile reported in Poor's Manual for the whole United States.

The striking feature in the latter table is the reduction of the proportion of working expenses, made in the face of an almost universal decrease in the average rates received, from 66 to less than 61 per cent.

Though efforts at economy are probably quite as earnest and as general this year as last, that as much can be effected by them as was done last year is not to be expected. Wages and materials reached their minimum, very nearly at least, before the end of last year. On the other hand, earnings may not show any decrease and may show considerable increase this year, though traffic is generally light and the rates on some of the most important railroads are lower than last year even.

RAILROAD EARNINGS, EXPENSES AND NET EARNINGS, YEAR 1874.

Name of Road.	Mileage. 1874.	Mileage. 1873.	Earnings. 1874.	Earnings. 1873.	Expenses. 1874.	Expenses. 1873.	Net Earnings. 1874.	Net Earnings. 1873.	P.c. of Exp's. 1874.	P.c. of Exp's. 1873.
Allegheny Valley	219	139	$2,389,472	$2,697,238	$1,470,785	$1,931,913	$918,687	$765,325	61.55	71.63
Atchison, Topeka & Santa Fe	507	501	1,252,428	1,240,249	559,101	757,907	693,327	482,342	44.64	61.11
Atchison & Nebraska	150	150	353,205	372,655	270,325	235,283	82,880	137,372	76.53	65.82
Atlantic & Gulf	346	346	1,032,256	1,005,947	725,180	712,189	307,076	293,758	70.25	70.80
Atlantic & Pacific	328	328	1,360,978	1,276,311	639,312	711,361	721,666	564,950	46.97	55.74
Belvidere Delaware	80	80	1,215,648	1,148,223	773,648	825,913	442,000	322,310	63.64	71.93
Camden & Atlantic	67	67	529,887	508,996	288,140	298,409	241,747	210,587	54.38	58.63
Central of New Jersey	293	293	8,589,631	8,881,366	4,140,601	4,215,584	4,449,030	4,665,782	48.00	47.00
Chartiers	23	23	71,156	61,293	52,504	42,038	18,652	19,255	73.79	68.59
Chicago & Alton	649	649	5,126,228	5,497,541	2,901,351	3,376,255	2,224,877	2,121,286	56.60	61.41
Chicago, Burlington & Quincy	1,264	1,264	11,645,318	11,405,226	6,513,512	6,434,768	5,131,806	4,970,458	56.93	56.41
Chicago, Milwaukee & St. Paul	1,399	1,384	8,953,017	9,046,124	5,871,116	6,594,560	3,081,901	2,451,564	68.32	72.90
Cleve., Col., Cin. & Indianapolis	471	471	4,248,606	4,887,449	3,182,155	3,423,398	1,066,451	1,464,051	74.90	70.04
Cleve., Mt. Vernon & Delaware	145	127	445,800	355,325	309,846	222,158	135,954	133,167	69.50	62.52
Cleveland & Pittsburgh	199	199	2,972,556	3,671,735	1,483,150	1,874,722	1,489,406	1,797,013	49.89	51.06
Col., Chi. & Ind. Central	587	587	3,863,832	4,477,807	2,929,842	4,244,624	933,990	233,183	75.83	94.79
Columbus & Hocking Valley	89	89	717,491	1,074,187	360,413	698,028	357,078	376,159	50.20	64.98
Detroit & Milwaukee	189	189	1,151,206	1,204,877	944,472	1,227,603	206,734	*22,726	82.04	101.89
Erie & Pittsburgh	84	84	872,613	1,165,293	490,226	680,894	382,387	484,399	56.18	58.40
Flint & Pere Marquette	241	237	1,063,986	1,126,198	668,995	711,603	394,991	414,595	62.88	63.19
Freehold & Jamesburg	28	28	66,397	62,226	66,299	72,333	98	*10,107	99.85	116.24
Gilman, Clinton & Springfield	111	111	252,490	253,315	157,462	222,389	95,028	30,926	62.36	87.79
Illinois Central	1,109	1,109	7,947,855	8,334,594	4,030,151	4,600,109	3,917,704	3,734,485	50.70	55.19
Indianapolis & Vincennes	117	117	274,595	253,784	191,387	191,647	83,208	62,137	69.70	75.52
Jeff., Mad. & Indianapolis	225	225	1,348,582	1,437,577	829,512	991,377	519,070	446,200	61.51	69.00
Knox & Lincoln	49	49	161,569	141,720	78,726	69,831	82,843	71,889	48.73	49.27
Lake Shore & Mich. Southern	1,175	1,154	17,146,131	19,414,509	11,152,372	13,746,599	5,993,759	5,667,910	65.04	70.90
Lawrence	22	22	174,643	189,383	109,109	113,371	65,534	76,012	62.48	59.86
Little Miami	197	197	1,448,056	1,401,548	1,072,186	1,239,530	375,870	162,018	74 04	88.44
Maine Central	356	356	2,094,080	2,065,360	1,281,681	1,330,501	812,399	734,859	61.20	64.42
Marietta & Cincinnati	287	284	2,094,511	2,126,875	1,571,360	1,694,336	523,151	432,539	75.02	79.66
Mo. River, Ft. Scott & Gulf	161	161	693,400	707,982	348,106	416,203	345,294	291,779	50.20	58.78
Mobile & Ohio	527	521	2,391,019	2,801,127	1,683,154	2,023,971	707,865	777,156	70.39	67.70
Morris & Essex	137	137	3,946,161	4,214,846	2,741,273	2,929,737	1,204,888	1,285,109	69.47	69.51
New Castle & Beaver Valley	15	15	352,319	351,089	131,267	158,575	221,052	192,514	37.26	45.17
New Jersey Southern	176	176	513,655	745,794	383,811	706,187	129,844	39,607	74.72	94.69
Northern Central	320	317	4,676,500	5,031,366	3,383,554	3,771,435	1,292,946	1,259,931	72.35	74.96
Oil Creek & Allegheny River	123	123	846,852	1,067,734	562,120	724,996	284,732	342,738	66.38	67.90
Pacific of Missouri	410	471	3,802,977	3,707,942	2,261,564	2,305,897	1,541,413	1,402,045	59.47	62.19
Pennsylvania, Main Line	358	358	20,299,331	22,308,482	11,013,477	12,907,730	9,285,854	9,400,752	54.26	57.86
Pennsylvania, Branches	519	511	2,343,040	2,577,527	1,688,041	1,988,646	654,999	588,881	72.04	77.15
Philadelphia & Erie	288	288	3,506,919	3,842,067	2,438,133	3,413,311	1,068,786	428,756	69.30	88.84
Pitts., Ft. Wayne & Chicago	468	468	8,599,472	9,619,074	5,055,330	6,097,042	3,544,142	3,522,032	58.79	63.30
Pittsburgh, Cin. & St. Louis	201	201	3,573,316	3,841,214	2,576,534	3,362,916	996,783	478,298	72.10	61.34
Quincy, Missouri & Pacific	70	70	107,151	92,739	90,602	85,549	16,549	7,190	84.62	92.24
Rome, Watertown & Ogdens	218	218	1,132,868	1,194,513	770,257	870,067	362,611	324,446	67.99	72.84
St. L., Alt. & T. H., Main Line	195	195	1,254,137	1,368,653	849,345	979,046	404,792	389,607	67.72	71.53
St. L., Alt. & T. H., Branches	71	71	559,347	587,485	299,679	310,846	259,668	276,639	53.58	52.91
St. Paul & Sioux City	122	122	545,190	539,834	393,318	463,773	151,872	76,061	72.00	86.00
Sioux City & St. Paul	148	148	281,115	224,088	191,750	273,550	89,365	*48,862	68.00	121.00
South Carolina	242	242	1,365,972	1,491,016	850,515	914,551	515,457	576,465	62.26	61.34
Sussex	31	31	124,445	129,165	67,630	86,234	56,815	42,931	54.35	66.76
Tuckerton	32	32	36,733	29,074	23,784	21,314	12,949	7,760	64.75	73.31
Union Pacific	1,032	1,032	10,559,880	10,266,104	4,652,315	4,974,861	5,907,565	5,291,243	44.05	48.46
United New Jersey	276	276	8,700,969	8,516,740	6,330,033	6,792,188	2,370,936	1,724,552	69.26	74.40
Western Union	213	213	1,123,108	1,137,634	768,164	878,241	354,944	259,393	68.40	77.22
West Jersey	128	128	623,391	680,856	475,169	405,129	148,222	275,727	76.22	59.53
West Wisconsin	197	197	884,920	869,189	697,107	591,975	187,813	277,214	78.78	68.11
Totals	17,684	17,581	$173,708,410	$184,728,865	$105,840,951	$121,945,203	$67,867,459	$62,783,662	60.93	66.01

* Deficiency.

Record of New Railroad Construction.

This number of the *Railroad Gazette* has information of the laying of track on new railroads as follows:

Easton & Amboy.—Completed by the laying of track through the Musconetcong Tunnel, N. J., 1 mile.

Peach Bottom.—The *Western Division* (of 3-feet gauge) has been extended eastward 5 miles to Bridgetown, Pa., 27 miles southeast of York.

Hanover & York.—Completed by the laying of 4 miles of track from Spring Forge, Pa., northeastward.

This is a total of 10 miles of new railroad, making 260 miles completed in the United States in 1875, against 436 miles reported for the same time in 1874 and 918 in 1873.

ENGLISH EXPERIENCE WITH STEEL BOILERS was referred to in the inaugural address of Mr. William Menelaus, the new President of the British Iron and Steel Institute, delivered just a week before our master mechanics debated at length the same subject. We publish the part of his address referring to this subject in another column, and call attention of our readers to it. Mr. Menelaus is one of the most famous of British iron manufacturers, of great experience and almost unequaled opportunities for ascertaining the results of experience in his country, which, it will be seen, he reports to be decidedly in favor of the use of steel.

Contributions.

Wells' Engine Applied to the Locomotive.

TO THE EDITOR OF THE RAILROAD GAZETTE:

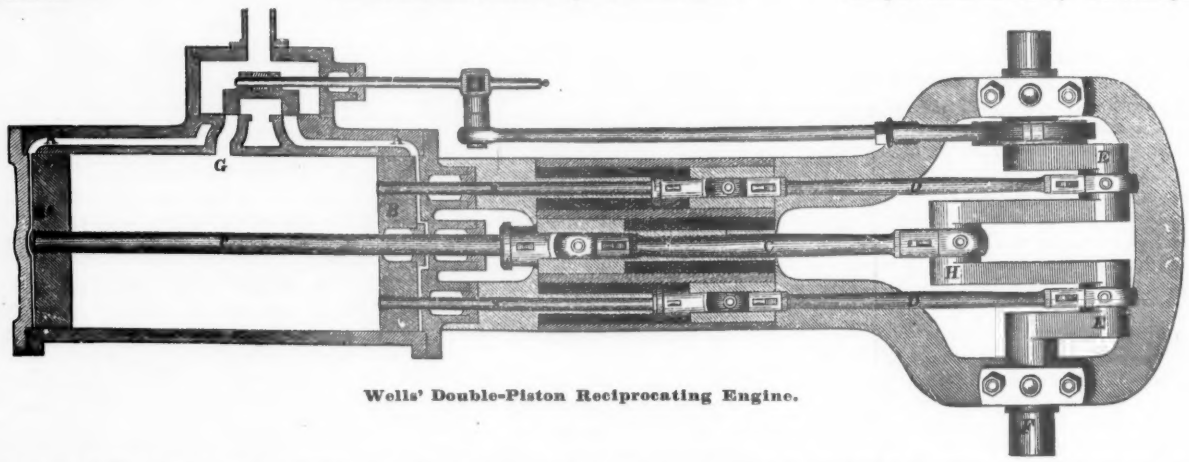
The accompanying engraving represents a double-piston reciprocating engine. *B, B²* are two pistons working simultaneously from the ends of the cylinder to its center and *vice versa*. *D, D, C* are the connecting rods acting on the cranks *E, E, H*. Steam enters through the ports *A, A²*, forcing both pistons in the opposite directions, and then through the port *A* forces them again to their former positions.

The advantage claimed for this form of engine is a perfectly self-balanced motion, which makes a much higher speed of the piston possible. If we could relieve our locomotive engines of all the internal disturbing motions, it would no doubt be an advantage, and it is worth while to look and see if we can obtain what is claimed by this new invention.

In a locomotive engine there are four disturbing forces during each revolution, acting in the form of jerks, which also make the locomotive swing round a vertical axis from one rail to another, resulting in a motion in a curve which has two concave and two convex parts in each revolution. The first motion can be easily seen by observing the concussions between locomotive and tender when they are not drawn close together, the second results in the shape of the wear of tires and flanges. The causes of those disturbing motions have been fully explained by Le Chatelier,* Redtenbacher and many others, and they are known to most engineers.

A locomotive in motion has a continuous change of the position of the center of gravity, resulting from the movement of the reciprocating parts, which must be reacted by the whole body. Another way of explaining this is this: The reciprocating parts are, during each stroke, started from a state of rest with accelerated motion which attains its maximum at half stroke. During the second half of the stroke the motion is retarded. This is only possible when the resistance on the crank pin is in the first half of the stroke smaller and in the second half larger than the pressure on the piston, and as the steam presses at the same time on the piston and the cylinder cover, the result is that the frames and all that is connected with them will be, during each stroke, pushed forward and then pulled backward. The same cause produces the swinging of a locomotive, because when the reciprocating parts of one engine attain their maximum acceleration, those of the other are in a state of rest; or when the motion on one side is accelerated that on the other is retarded; this creates a motion round a vertical axis.

The swinging of the locomotive is probably one of the principal factors in the wear of tires and rails. To overcome the internal disturbing forces in a locomotive engine the counterbalance weights are applied to the drivers, but practically they never can be entirely neutralized.



Wells' Double-Piston Reciprocating Engine.

There is, however, an evil created by the applications of counter weights, which is the centrifugal force resulting from the revolving masses of those weights. To show its effect on the adhesion we take the following example: If L represents the weight on one driver, p the force on the crank-pin which increases the adhesion, owing to the angularity of the connecting rod, W the weight of counterbalance, r the distance of its center of gravity from the axis,—g the acceleration of the gravitation = 32, D diameter of the driving-wheel, V = the speed of the locomotive in one second, and C = the centrifugal force, we have

$$C = \frac{W}{g} V^2 \left\{\frac{2r}{D}\right\}^2 \frac{1}{r}$$

For an ordinary express locomotive with 16 × 24 cylinders and 5 ft. 6 in. driving-wheels, we can take: L = 10,000 lbs., W = 175 lbs., r = 1.8 ft., V = 51.3 ft., which gives a speed of 35 miles to an hour. Substituting in the above formula, we find

C = 3,416 lbs.

which is the centrifugal force that acts vertically upwards whenever the counterbalance is above the axle, and acts downward when it is below the axle.

Supposing, now, the steam to be cut off at half stroke, and the length of connecting-rod 7 feet, we will find p to be equal to 2,379 lbs. in cases when the crank-pin is above or below the axle.

The adhesion in one case is = $L + p + C$ = 15,795 lbs.; in another = $L + p - C$ = 8,963 lbs., which gives a difference of 27.6 per cent. of the mean adhesion, probably not enough to show distinctly that the tire does not wear out uniformly on the whole circumference.

As the centrifugal force increases in proportion to the square of the velocity, a speed will soon be reached when there will be no adhesion on the driver at all. It must be then $C = L + p$, or

$$V = \sqrt{\left\{g \frac{L+p}{W} \left\{\frac{D}{2r}\right\}^2 r\right\}}$$

Substituting the above figures, we find V = 97 ft., which gives a speed of 66 miles to an hour.

From this we see that it is dangerous and uneconomical to make much faster speed than that which is at present customary, as the engine would be liable to leave the track, the wheels would slip whenever the counterbalance is above the axle, and the wear and tear of engine and track would be largely increased on account of the disturbing motion.

By applying the Wells patent engine to the locomotive those evils are overcome, and it is easy to demonstrate this.

There are two pistons traveling in opposite directions; both reach the maximum acceleration at the same time, and acting on cranks at 180° they balance each other perfectly.† As each engine is balanced for itself, it follows that there are neither one of the disturbing motions, no jerks and no swinging. Only the so-called pitching of the locomotive remains, which is the alternate heaving and sinking resulting from the angularity of the connecting-rod, a motion which is neutralized by springs and a long wheel-base.

With those engines we can increase the speed of a locomotive without fear of her leaving the track or of slipping of wheels, and without increase in the wear and tear which result from the disturbing motions. The cars will also run more steadily, free from jerks and lateral motions, so disagreeable to passengers when making fast time. Only the rolling friction and the shocks resulting from the irregularity of the track will remain. Some saving will be probably made on fuel, but how much experiment can only determine. It was found by tests made in England, with locomotives having balanced driving-wheels and others not balanced, that the saving in fuel was 11 per cent. in the former case. Still more economy will, no doubt, be gained when the balancing is more perfect.

We see farther that in Wells' engine each piston travels only half as far as that of a single-piston engine to one revolution of the crank, and, having the same piston speed, we double the revolution. This gives also more facilities for proportioning the size of driving-wheels to the cylinders, allowing an increase of the number of revolutions without increasing the piston speed. ‡

In a locomotive with the Wells' cylinders the only strain on the bearing of the driving-axle, outside of that which comes from the weight resting on the box, is that of the tractive force alone, being much less than is the case with a common engine, and it is so because the steam acts once on both covers of the cylinders, another time on the pistons only, and then no strain can be transmitted from the cylinders to the frame.

To show how the strain acts on bearings in a common engine, I refer to the Question 312 of Mr. Forney's "Catechism of the Locomotive." In the example given there the strain is 13,333 lbs. when the crank is above the axle, and 6,666 lbs. when the crank-pin is below the axle, and from the same engine with double piston the strain would be only 3,333 lbs., which is the tractive force alone. By diminishing the strain we diminish the friction.

There will not be much difficulty in applying these cylinders on the outside of the frames, and the disadvantages are only in increasing the number of connecting-rods, cross-heads and pistons. This gives an extra cost, but practical experiment would soon show whether the advantage resulting therefrom would repay such extra cost. All that I wish to say is, that the principle itself is a very good one, and ought practically to give good satisfaction.

Wells' cylinders can also be advantageously used for stationary engines, as the movements of the reciprocating parts are balanced, the piston speed can be largely increased, and so we can have an engine of the same horse-power made of smaller dimensions. They require but a light frame and foundation.

The company expect soon to have an engine on this plan, that will show better the advantages claimed for it.

THOS. KRAJEWSKI, M. E.

No. 73 BROADWAY, NEW YORK.

*Le Chatelier was the first who applied counterbalance weight to the drivers, yet I think it would be proper to repeat briefly what has been explained by them in order to have the matter more complete.

†The weight of the reciprocating parts moving in one direction has to be equal to that of the reciprocating parts moving in the opposite direction.

‡Compare with the English locomotive illustrated in *Engineering* for April, 1875.

American Securities in Holland.

AMSTERDAM, Holland, May 9, 1875.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In Holland the amount of "saved" capital, for which yearly State and railroad bonds are bought, exceeds that of the largest States of Europe. A great many of our countrymen invested their money in the United States bonds of 1882 and 1885, and took an enormous profit from it at the end of the civil war. Seduced by this success, they looked out for other investments, large annual interest being the first aim of such investors. Little acquainted with the resources and the financial position of several railroads, and the character of real estate investments, the inquiries into which were often hindered by the obscurity in which these estates and railroad companies were involved, they could not separate sufficiently the wheat from the chaff. Thus, for instance, all the bonds of the *main* and *branch lines* and the *extensions* of the St. Paul & Pacific Railroad Company were sold at Amsterdam ($25,000,000) for the greatest part at about 70 per cent. (the quotation of the extension bonds being now nearly 7 per cent.) Also, two 7 per cent. *mortgage loans* were issued here for the *Maxwell Estate Company* (Beaubien and Miranda grant) to an amount of £975,000, at from 72 to 75 per cent., besides $5,000,000 of worthless stock, sold at the price of 50 per cent. (now they are 2 per cent.), *though the patent for this grant was never given.* A great part of this and similar loans are, as I suppose, even unknown in the United States. I do not wish to paint here the ruin caused in Holland by the inevitable and disastrous circumstances of the last years (the French war of 1870, the panic of 1873), only it may be said, that of the seventy different American railroad and real-estate investments made in Amsterdam during the last ten years, the greatest portion of the interest is not paid. The total losses in capital here are reckoned to be, in the last five years, about $150,000,000. The purchasers of these bonds were nearly all persons in moderate circumstances, small farmers and trades people, who believed they were investing their savings in reliable American enterprises.

Now we are living in the age of committees, seeking for means of redress, at the same time instituted by the bankers concerned to turn over the responsibility of their acts in part to other persons. A dozen committees were formed, but as yet, though some of them have been existing for two years, the effect has been only a negative one, and the prices of the bonds for which they were made are falling slowly, but continually. The solid American bonds are represented here scarcely in proportion to the bad ones; they did not offer such enormous profits to the selling firms.

During the last months the opinion begins to become somewhat better; the prosecution in the United States against rings and frauds has contributed very much to this better feeling, and though not every one likes Jay Gould, they have to-day a much better opinion of him than at the time that he was associated with Fisk. His last operations in Union Pacific have given him many friends in our country. Our countrymen, desirous as they are of making money, do not ask too much for the causes and means.

Gradually the demand for American solid railroad bonds increases. An enormous quantity of pamphlets and several new financial papers have caused a greater knowledge of the worth of different securities, and it seems that the investment in American bonds and stocks will be again one of the most important. The arrangements made by some companies have also made a good impression. So far as concerns business on the Amsterdam Stock Exchange (though this name is not entirely exact, being very little a trade in *stocks*—nearly nothing, compared with the trade in mortgage bonds), it is of the greatest importance. The large capital born of the commerce of the last two centuries, the enormous treasures actually flowing from the colonies (Java, Sumatra, Borneo) to the mother country, jointly with the lessons given by the panic of 1848, banished from the Stock Exchange all the trade *on account*, leaving only the trade *for money;* while on the other European exchanges (London, Paris, Berlin, Vienna) trade *for money* is the exception. This practice makes the position of the Amsterdam market very strong, and the silver standard also prevents the bankers from inundating the market with foreign bonds and securities in disastrous times. But it is feared that within a short period the gold standard will be introduced connected with the silver one, the bankers working continually in this way by depression of the quotation of foreign bills, and so artificially creating the idea that the commercial interests of Holland are hurt by the silver standard. But the real cause of their acting so seems to be the experience they had with the French fine, which had to be paid in gold at London, at a time when the French, Austrian and Italian banks were not paying their notes in gold, and Russia was holding its gold, pretendedly for minting new coin. It was inevitable that England, where such an amount of gold could not be found, should take gold from America continually, and this has been one of the causes of the panic, there being at that time little export of bonds from the United States. The bankers are now taking precautions for similar circumstances, and will, when they reach their aim, have the chance to withdraw also the gold from Holland. They are working very steadily, convinced that the religious troubles and political difficulties in Germany will again end in a war, in which France, though it would like to escape from it this year, will be involved.

As to the form of the trade on the Amsterdam Stock Exchange, it is quite different from that of New York. There is

no *call* here, and entrance is allowed to every one. The trade begins at 1 o'clock. From 1 to 1½ bankers' bills are dealt in; at 1¼ o'clock all the commercial and bond and stock brokers and dealers begin their trade. Nearly half of the building is occupied by the brokers and dealers, continually trading, in several groups, in all the sorts of bonds and stocks, till 3 o'clock, when the official quotations are stated in a meeting by the members of the "Society for the Interests of the Trade in Bonds and Securities;" the free list being without official control. The *Bank of the Netherlands* paying all its notes in silver, there is no difference in price between currency or bank notes and money. No other bank has the right to issue notes. This correspondence being my first, I thought it not useless to give a general idea of the position and usages of the Amsterdam Stock Exchange. After this little excursion I pass to the report of the first week of May. It will be only a short account, as I desire not to take more space in this paper than is necessary. During the first week, (May 3 to 8) there was a tendency to weakness in the market. The Prussian *note* to Belgium and the unsatisfactory answer causing fear of political difficulties. The trouble of Philipart, a leading banker in Paris, to prolong (report) 40,000 shares of the *Credit Mobilier*, caused great sales in European bonds by bankers complicated in the matter. The last day of the week an article in the *Post*, of Berlin, broke down the prices of all the European bonds, and the market closed very dull. In American bonds there was much trade in *St. Paul & Pacific* and *West Wisconsin* bonds. Mr. Klein, our Vice-Consul for Minnesota, and Secretary of Director Trott, came over here and wished to negotiate with the bondholders; but as the committee was not recognized by the St. Paul & Pacific Railroad Company as representing the bondholders, and as Mr. Klein wished to negotiate directly with the bondholders without the committee, there is but little chance of success. The propositions made by the West Wisconsin Railway Company are not liked here, and it is the intention of holders of £20,000 of bonds in London to demand foreclosure, according to the mortgage act. *Erie* and *Union* shares followed the New York market; in the former the influence of the London sellers is very great, and we are here very often under New York prices; in Union shares our public was seller till the price of 68 per cent. During this week there were large sales for New York. In *Missouri, Kansas & Texas* the market was very strong, as the rumor says that the new President will come over to make again an arrangement. After the bad issue of the arrangement with Levi Parsons, we do not believe that the bondholders will be inclined to give their adhesion to anything but foreclosure.

The quotations of this week were as follows:

	Highest.	Lowest.	Closing.
American bonds 1882	96⅛	95¾	95¾
American bonds 1885	99⅞	99⅝	99⅝
Union Pacific 6s	82¾	81¾	81¾
Union Pacific shares	63⅛	62	62
Erie shares	25⅝	24⅜	24⅜
Chicago & N. W., preferred	46⅞	45⅝	45⅝
Chicago & N. W., consolidated 7s	72½	71⅜	72
Central Pacific 6s	85	83½	83½
At. & G. W. Ohio 7s	68	67½	67½
Mo., Kan. & Tex. 7s	35⅛	33⅞	35⅛
At., Miss. & Ohio 7s	47⅜	46	46
Kansas Pacific 7s	64¾	63½	36¼
West Wisconsin 7s	37	36	36
St. Paul & Pac. br. line 7s	37	35	35
St. Paul & Pac. main 7s	18¾	17¾	17⅞
St. Paul & Pac. 1869 7s	17⅞	15⅞	15⅞

May 16, 1875.

There was a generally better tone in all the markets of Europe, sympathizing with the improvement in prices coming daily from the Paris Bourse. Austrian State bonds (nearly half of which are in the hands of the Holland public), the thermometer of our Stock Exchange, were 1⅛ per cent. higher, from 60 to 61⅛.

No alteration in the banks' rates has been made this week. Discount remains 3½ per cent. The demand for money in the open market was very active at the beginning of the week, for *prolongation* (lending for one month upon pledge of solid State bonds, with a margin of at least 10 per cent.). The maximum was 5 per cent., but at the end of the week it fell to 3½.

The great capitalists prefer to lend their money at a lower rate rather than buy any securities, chiefly because they believe that the great bankers will not remain unmoved by Philippart, who injured their interests and those of the French railroad companies, and will cause a new decline to attain their object.

In American State bonds there was but little business. There was much more in railroad securities, principally in Chicago & Northwestern preferred stock, and in Missouri, Kansas & Texas, West Wisconsin, Kansas Pacific and Denver Pacific bonds. These were bought for the account of American bankers. Denver & Rio Grande reacted 3¼ per cent. Toledo, Peoria & Warsaw was 15 per cent. lower than previous quotations, Union Pacific and Erie shares followed New York quotations. Large sales of Erie were made by London bankers. With regard to Maxwell Land Grant & Railway, Mr. John Collinson, formerly President of the company, has made to the stock and bondholders a proposition for reorganization of such a curious character that I do not know whether we should laugh or be indignant at it. He proposes to form a new company, the "Western American Trust Company," to be incorporated in America, the members to be such persons as he shall select. This company is to have authority to issue $3,750,000 of "deferred stock," $3,750,000 of 10 per cent. preferred stock, $4,250,000 of 5 per cent. consolidated gold bonds, due in 30 years, making a total capital of $11,750,000. The objects of the company to be (*a*) to obtain control of the Maxwell property and administer its affairs; (*b*) to secure a railroad connection to Cimarron, New Mexico. He contributes nothing, in his new company, but will give us for the $5,000,000 of Maxwell shares (sold here at 50) 10 per cent. deferred and 10 per cent. preferred stock: for the Maxwell bonds (sold here from 70 to 75) 50 per cent. of their face in preferred stock and 50 per cent. in his 5 per cent. bonds. For the balance of $3,250,000 of deferred stock, $500,000 of preferred stock and $1,500,000 of 5 per cent. bonds he *promises* to build a narrow-gauge railroad from the boundary of the estate to Cimarron (80 miles) if another company (the Atchison, Topeka & Santa Fe, or the Denver & Rio Grande) will build a line from their present terminus to the boundary. By this proposal the board and stockholders would have to give up their rights for a new operation in the hands of a man of whom they bought not only Maxwell bonds at an enormous price, but also, in 1870, 8 per cent. Florida State bonds (sold here at 80 gold), of a loan which was not recognized by that State. As it seems that the title is not a legal one, it is supposed by many that the proposal is an endeavor to bury the question at the same time with the quasi-possession. There was a meeting this week which was deferred for a week, Dr. A. W. de Klerck insisting upon it that the participants should have time to consider the proposal, which was not communicated until the assembly of the meeting. The question put by this gentleman concerning the legality of the form of sale (the sellers stipulated that the buyers should give the whole amount of stock in payment), and the legality of the title (the property is not salable without a patent) could not be answered; therefore, John Collinson will be asked to come here and be present at the next meeting. There is little chance that the proposition will be accepted; and if it were, the public would not exchange their stock and bonds for the securities of his *future* "Western American Trust Company." Our public will not buy his issue in excess of the amount to be paid for the outstanding Maxwell securities, and I do not believe that the New York market will buy products of Collinson's intelligence.

General Railroad News.

TRAFFIC AND EARNINGS.

Flour and Grain Movement.

For the week ending May 22, receipts and shipments (flour in barrels and grain in bushels) are reported as follows:

	1875.	1874.	Inc. or Dec.	P. c.
Flour:—				
Lake ports' receipts	122,173	119,228	Inc.... 2,945	2.5
" " shipments	122,337	115,383	Inc.... 6,954	6.0
Atlantic ports' receipts	186,447	200,144	Dec.... 13,697	6.8
Wheat:—				
Lake ports' receipts	1,082,566	1,720,669	Dec... 638,103	37.1
" " shipments	1,184,591	1,967,368	Dec... 782,777	39.7
Atlantic ports' receipts	677,282	2,006,896	Dec. 1,329,614	66.4
Corn:—				
Lake ports' receipts	744,050	1,333,896	Dec... 589,846	44.3
" " shipments	788,898	1,550,626	Dec... 761,728	49.1
Atlantic ports' receipts	787,432	960,643	Dec... 173,211	17.5
Grain of all kinds:—				
Lake ports' receipts	2,280,422	3,830,515	Dec. 1,550,093	40.7
" " shipments	2,416,771	4,110,859	Dec. 1,694,088	41.2
Atlantic ports' receipts	1,891,558	3,492,002	Dec. 1,600,444	45.7

Here the greatest decreases are in sea-board receipts, contrary to the showings heretofore, in which sea-board receipts have not shown nearly so large a falling off as Western receipts and shipments. Notwithstanding the great decrease in movement, compared with last year, Western receipts for the calendar year have been almost exactly the same as in 1873, (150,000 bushels greater), and the shipments not 8 per cent. less. Of the Western shipments for the week, 52 per cent. of the flour and 35 per cent. of the grain went by rail this year, against 54 per cent of the flour and 30 per cent. of the grain in 1874, and 55 per cent. of the flour and 22¼ per cent. of the grain in 1873.

Of the grain shipments from Buffalo for the same week, 45 per cent. went by rail.

In seaboard receipts for the week, New York maintains its rank as first in all grains in which there are any important receipts, but Montreal ranks next in both flour and wheat. New York took 29 per cent. of the flour and 46 per cent. of the wheat; Montreal, 19 per cent. of the flour and 33 per cent. of the wheat. In corn Baltimore stands next to New York, receiving 23 per cent. of the whole, while New York got 41 per cent. and Boston 16½ per cent.

Exports.—The imports of wheat into the United Kingdom for the four months from Jan. 18 to April 30 were nearly a fifth less this year than last. The imports from the United States decreased very little, however—less than 3 per cent. For the crop year, beginning with Sept. 1 down to May 25 for New York, May 22 for Philadelphia and Boston, May 19 for New Orleans, and May 14 for San Francisco, the exports of wheat from the United States to Europe were not quite an eighth less this year than last, the corn exports nearly a fifth less. *San Francisco leads in wheat exports*, having shipped nearly one-half of the whole, and a quarter more than New York. Baltimore is third, with 4¼ per cent. of the whole wheat exports. New York exported 51⅓ per cent., Baltimore 27 per cent., Philadelphia 16 per cent., Boston 5 per cent. of the corn. The total wheat exports to those dates had been 35,654,000 bushels this year, 43,072,000 last year, 21,844,000 in 1872-3.

For the week ending May 29 Chicago receipts were 57,637 barrels of flour and 1,439,950 bushels of grain of all kinds, in 1875, against 42,480 barrels of flour and 2,740,358 bushels of grain for the corresponding week of last year, showing an increase of 31⅝ per cent. in flour, and a decrease of 47½ per cent. in grain. The shipments for the same week were 55,347 barrels of flour and 1,485,801 bushels of grain this year, against 40,470 barrels of flour and 2,248,956 bushels of grain last year, an increase of 37⅓ per cent. in flour and a decrease of 34 per cent. in grain. Thus grain accumulated in Chicago during the week.

Baltimore flour and grain receipts for May were:

	1875.	1874.	Inc. or Dec.	P. c.
Flour, barrels	103,160	135,562	Dec.. 32,402	23⅞
Wheat, bushels	258,805	706,450	Dec.. 447,645	63⅜
Corn	887,966	1,052,297	Dec.. 164,331	15⅝
Other grain	72,820	83,543	Dec.. 10,723	12⅞

Coal Movement.

The following tonnages are reported for the week ending May 22:

	1875.	1874.	Inc. or Dec.	P. c.
Anthracite	291,495	495,822	Dec..204,327	41¼
Semi-bituminous, Broad Top and Clearfield	18,681	.....	.....	....
Cumberland	68,634	.....	.....	....
Bituminous, Western Pa.	30,496	.....	.....	....
" West Va.	4,030	.....	.....	....
Coke, Western Pa.	9,571	.....	.....	....

The Pennsylvania Railroad coal tonnage for the second week in May was:

	Tons.
Anthracite	17,648
Bituminous	48,730
Coke	9,584
Total	75,962

Lake Traffic.

At a single shipment 206,000 bushels of grain were forwarded from Chicago, May 29. The propeller Graves, loaded with 37,000 bushels of corn, towed the Russell, with 48,000 bushels of wheat, and a new vessel, the George W. Adams, with no less than 121,000 bushels of oats. This shipment would have loaded no less than 575 ordinary grain cars. The tendency on the lakes is toward the use of immense vessels towed by smaller steamers. In this case the load of the largest vessel were 3,300 tons, and yet it drew but 13½ feet of water.

A vessel arriving at Sarnia, May 27, reported running through 90 miles of ice in Lake Superior.

Rates from Chicago are reported as 3¾ cents per bushel for corn to Buffalo, 8 cents to Ogdensburg, and 12 cents to Montreal. Coal is carried from Buffalo to Chicago for 50 cents per ton, which is about one-twentieth of a cent per ton per mile.

Railroad Earnings.

The following reports have been made:

	1874.	1873.	Inc. or Dec.	P. c.
Year 1874:				
Mineral Range	$99,121	.....	.....	....
Expenses	55,358	.....	.....	....
Net earnings	$43,763	.....	.....	....
Earnings per mile	7,930	.....	.....	....
Per cent of expenses	55.85	.....	.....	....
Year ending March 31:	1874-75.	1873-74.		
Boston, Concord & Mont.	$664,194	$687,129	Dec.. $22,935	3⅜
Expenses	523,986	550,981	Dec.. 26,995	4⅞
Net earnings	$140,208	$136,148	Inc... $4,060	3
Earnings per mile	4,151	4,521	Dec.. 370	8⅛
Per cent. of expenses	78.89	80.17	Dec.. 1.28	1⅝
Macon & Augusta	$115,451	$121,375	Dec.. $5,924	4⅞
Expenses	103,364	100,406	Dec.. 2,958	3
Net earnings	$12,087	$20,969	Dec.. $8,882	42⅜
Earnings per mile	1,480	1,556	Dec.. 76	4⅞
Per cent. of expenses	89.53	82.72	Inc.. 6.81	8⅛
Four months ending April 1:	1875.	1874.		
Ind., Bloomington & West.	$440,724	$564,890	Dec..$124,166	22
Expenses	424,088	560,712	Dec.. 136,624	24⅜
Net earnings	$16,636	$4,178	Inc .. $12,458	298⅛
Per cent. of expenses	96.23	99.26	Dec.. 3.03	3
Month of April:	1875.	1874.		
Philadelphia & Erie	$277,947	$274,054	Inc.. $3,893	1⅜
Expenses	173,893	231,167	Dec.. 57,334	24⅞
Net earnings	$104,114	$42,887	Inc.. $61,227	142⅞
Earnings per mile	955	952	Inc.. 13	1⅜
Per cent. of expenses	62.54	84.35	Inc.. 21.81	25⅞
Kansas Pacific	$291,651	$292,143	Dec.. 492	0⅛
Last two weeks in April:	1875.			
Detroit & Milwaukee	$48,912	.....	.....	....
Expenses	34,269	.....	.....	....
Net earnings	$14,643	.....	.....	....
Second week in May:				
St. Louis, Iron Mt. & So.	$58,346	$60,300	Dec.. $1,954	3¼
Third week in May:				
Denver & Rio Grande	$8,443	$8,439	Inc.. $4	....
Week ending May 7:				
Great Western	£17,030	£20,210	Dec.. £3,180	15¾
Week ending May 8:				
Grand Trunk	£34,500	£42,100	Dec.. £7,600	18⅛
Week ending May 14:				
Great Western	£16,201	£19,963	Dec.. £3,762	18¾
Week ending May 15:				
Grand Trunk	£36,100	£42,600	Dec.. £6,500	15¼

PERSONAL.

—It is stated that Col. J. J. Lawrence has tendered his resignation of his position as General Superintendent of the Allegheny Valley Railroad, to take effect June 15.

—Mr. Stephen S. l'Hommedieu, an old and prominent citizen of Cincinnati and for several years President of the Cincinnati, Hamilton & Dayton Railroad Company, died May 25, while on a visit to West Point, N. Y. He was also a director of the Ohio & Mississippi and was interested in other railroad enterprises.

—Mr. Wm. H. Gatzmer, for many years Superintendent and afterwards President of the Camden & Amboy Railroad Company and later President of the joint board of the United Companies, is lying very dangerously sick at his residence at Tacony, near Philadelphia, and is not expected to recover.

—Mr. John W. McManus, of Reading, Pa., died June 2 in that city. He was a prominent and extensive railroad contractor, and was a director in the Texas & Pacific Company. He was, we believe, largely interested in the California & Texas Construction Company. He had been engaged on many important works.

THE SCRAP HEAP.

Railroad Manufactures.

The Bethlehem Iron Company and the Pennsylvania Steel Company have taken a contract for supplying the Southern Pacific Railroad Company with 5,000 tons of steel rails each, to weigh 50 lbs. per yard. It is said that the freight from Jersey City to San Francisco (going around the Horn) will not be more than $10 per ton.

The Vulcan Iron Works of St. Louis is to put up plant for Bessemer steel—the first west of the Mississippi. There are now eight Bessemer works in operation in this country, and two more to be opened next fall.

The Decatur (Ill.) Rolling Mills have been closed, and it is reported that the machinery will be removed to Kansas City.

The Mason Machine Works, at Taunton, Mass., are building some engines for the Boston, Revere Beach & Lynn road.

The Canton (O.) Wrought Iron Bridge Company has under contract $160,000 worth of bridge-work, including the draw span and pier for the new railroad bridge over the Saginaw River at East Saginaw, Mich. This draw will be of 200 feet span and rest on a wrought-iron cylinder pier.

The Valley Mills, at Youngstown, O., are re-rolling 1,000 tons of rails for the Atlantic & Great Western.

The Newark (O.) Rolling Mill is being fitted up to make bar iron as well as rails, and will commence running again the first of next month.

The Indianapolis Rolling Mill is at work on an order for iron rails for the Whitewater Valley road.

The Fitchburg Machine Company, at Fitchburg, Mass., has recently increased its working force and now has its shops nearly full, with a large number of orders ahead. The company makes a great variety of machine tools, lathes, planers, shaping machines, drills, milling machines, etc., and its tools are largely used in railroad shops. The company recently shipped a number of tools for the shops of the Havana Railroad Company, at Havana, Cuba.

The Loughridge Air Brake.

This brake has been adopted by the Cumberland & Pennsylvania Railroad Company. There will be an excellent opportunity to test its efficiency fully on the steep grades of that road.

OLD AND NEW ROADS.

Ca ifornia Pacific.

The Vallejo (Cal.) *Chronicle* of recent date says: "In yesterday's *Chronicle* we published the report that a compromise had been effected between the German bondholders and the Central Pacific people in the California Pacific suit. We are now able to state the report is correct to the extent of the agreement of a majority of the parties interested. The terms of settlement are as follows: The railroad company are to pay 50 per cent. of the principal of the Extension or second-mortgage bonds when they fall due, but are to pay full interest (7 per cent.) on the whole amount. The whole amount is $3,500,000, so that the company will make by this part of the transaction the present worth of $1,750,000 at 7 per cent., due fourteen years hence, the bonds being payable July 1, 1889.

"The first income bonds, of which the issue is $1,000,000 at 10 per cent., and the second income or double track bonds, of which the issue is $1,600,000 at 6 per cent., are to be paid in full, but the interest cut down to 3½ per cent. The two last-mentioned issues are said to be mostly owned by the company's directors or their friends. If this agreement is ratified, of which there is little doubt—a majority, as we before remarked, favoring it—the California Pacific will come under the complete ownership of the Central Pacific people. A leading director of the company says that within one hundred days after ratification of the compromise, the iron horse will be snorting over the extension of the road from Woodland to Colusa. The enlargement of the terminal facilities at South Vallejo, by the laying of additional side tracks, etc., is being done with a view to the construction of this extension."

Central Vermont.

Both the Smith board of directors and the Page, or opposition board, which also claims to be elected, have organized and elected a full complement of officers. The Smith board has procured opinions from Judge Redfield and several other Boston lawyers to the effect that the issue of stock just before the meeting was legal, but these, of course, have no binding force and the matter must be decided by the Courts. In that case we may see the somewhat unusual proceeding of a Court appointing a receiver of a receiver, for it must be remembered that the Central Vermont Company owns no road, but operates the Vermont Central and the other roads included in the trust as receiver, under directions of the Court. The matter will probably lead to further tedious litigation.

Indianapolis, Bloomington & Western.

General Wright, the Receiver, has issued a circular to the the employes, explaining the reason why no more of their back wages has been paid. He says that it is only by the strictest economy that he has been able to pay current expenses, and that there has been no surplus whatever. In conclusion, he thanks them for their faithful performance of duty and their patience under difficult circumstances.

The difficulty with the Peoria & Springfield Company has been settled, as noted elsewhere.

Macon & Brunswick.

This road was sold at auction June 1 to satisfy the liens held by the State of Georgia. It was bid in by the State for $1,000,000.

Chicago, Clinton & Western.

Active work is in progress west of Clinton, Ia. The road-bed is being graded, and a bridge 300 feet long is being built over Mill Creek. Wallbaum & Bridges are sub-contractors under Mr. Hinckley on the section now being built.

Chicago & South Atlantic.

This company has filed its articles of incorporation with the Secretary of State of Indiana. The capital stock is to be $1,000,000, and the road is to extend from Chicago by way of Indianapolis to Rising Sun on the Ohio River. It is to be about 280 miles long.

Frankfort, Muncie & Bloomington.

This company has filed new articles of incorporation in Indiana. The capital is to be $2,000,000, and the road is to extend from Muncie, Ind., west to the Illinois line, using the abandoned road-bed built by the Lafayette, Muncie & Bloomington Company.

Western, of Alabama.

The Chancellor has confirmed the sale and ordered the road to be transferred to the purchasers, the Central of Georgia and the Georgia companies.

As soon as the new arrangements are completed the eastern terminus of the road will be at Opelika, Ala., the junction of the two branches to West Point and Columbus. The Central trains will run through Opelika by way of Columbus and the Georgia trains by way of West Point.

Toledo, Wabash & Western.

Work in the shops at Springfield, Ill., has been suspended for the present. When resumed, the shops will be run eight hours daily.

St. Louis, Kansas City & Northern.

There are reports current of a combination and agreement between this company and the Kansas Pacific, the managers of the latter company having, it is said, secured control of the St. Louis, Kansas City & Northern.

Dividends.

Dividends have been declared by the following companies:

Northern, of New Hampshire, 3½ per cent., semi-annual, payable June 1.

Agricultural Branch (stock guaranteed by Boston, Clinton & Fitchburg), 3 per cent., semi-annual, payable June 1.

Union Pacific, 1¼ per cent., quarterly, payable July 1.

Erie.

Application was made to the Chancellor of New Jersey, June 1, to have Mr. H. J. Jewett appointed Receiver of the company's property in that State. The appointment was opposed by the Jefferson Car Company and the National Stock Yard Company, their counsel urging the close connection of Mr. Jewett with the late management, and asking that a disinterested party be appointed Receiver to protect the rights of the creditors. After hearing arguments on both sides the Chancellor took the papers and reserved his decision.

Work is progressing rapidly on the new Portage Bridge. The masonry piers remaining in place were not much injured by the fire and have only a heavy cap added to make them ready for the iron pieces which will rest upon them. Only one-half the former number of piers will be used, however, the new bridge being in spans of 100 feet each. The iron work is already beginning to arrive from Paterson.

Peoria & Springfield.

Mention was made last week of trouble between this company and the Indianapolis, Bloomington & Western, which has heretofore leased the road. It appears that General Wright, the Receiver of the Bloomington road, objected to the former lease on the ground that the rent was too great, and a new contract was drawn up by which the rental to be paid was based upon the tonnage moved over the road. The managers soon after made arrangements to lease the use of their track also to the Toledo, Wabash & Western, to which objections were made by the other company. The matter has, however, been finally settled, and the Peoria & Springfield road will be used by both the Bloomington and the Wabash trains, the company nominally operating its own road and appointing a train dispatcher who shall have control of the movement of trains. The rentals paid will be based on the tonnage moved.

Some of the bondholders of the Peoria & Springfield during the trouble made application to the Peoria Circuit Court and had James Haines, President of the company, appointed Receiver.

Indianapolis & Springfield.

The township of Center, Ind., has voted to subscribe $50,000 to this company's stock.

Wyandotte, Kansas City & Northwestern.

Kaw township, in which Kansas City is situated, subscribed $150,000 in bonds in aid of this road, of which $75,000 were paid over on the completion of the road to Independence, the rest being retained until the road should be finished to the coal fields of Lafayette County. This extension is not built, but the company is trying to induce the County Court to deliver the rest of the bonds, a proceeding that naturally excites much opposition.

Chicago, Saginaw & Canada.

This company has been advertising for proposals for laying and ballasting 20 miles of track, from St. Louis, Mich., westward.

Baltimore & Ohio.

After an interview with President Garrett, the Postmaster General addressed a letter to President Scott saying that he was entirely satisfied with the way in which the mails between Washington and New York are now carried and desired no change, thus throwing upon the Pennsylvania company the entire responsibility of the refusal to haul the Baltimore & Ohio postal cars from Philadelphia to New York.

The Baltimore & Ohio cars were refused passage, June 1, according to the previous notice, and on that day the mail had to be transferred to a Pennsylvania car at West Philadelphia. The Postmaster General, on the ground that he cannot allow the public to suffer from the quarrels of the companies, has concluded to send, for the present, all the mails by the Baltimore & Potomac.

International & Great Northern.

The general offices of this company will be removed from Houston, Tex., to Palestine, June 15. The company is erecting large shops at Palestine, and the general repair shops will be located there at the same time. It is well located for the headquarters of the road, being at the intersection of three divisions, the Great Northern, from Houston to Palestine, the Eastern Division of the International, from Palestine to Longview, and the Western Division, which now extends to Rockdale, but will hereafter run to Austin and San Antonio.

The engineers are now surveying the extension from Rockdale to Austin, and hope to begin construction in the Fall.

Syracuse Northern.

A special meeting of stockholders was held at Syracuse, N. Y., May 29, to consult with respect to the proceedings for the foreclosure of the second mortgage, which have been pending for several months. After listening to several addresses the meeting adjourned without taking any action.

Detroit & Milwaukee.

The Receiver reports that on his taking possession April 15, there was due for interest on mortgage debt $686,823.70. The floating debt, including arrears of wages, was $566,724.55, and the available cash assets were $20,953.14. The net earnings for the last half of April were $14,642.75.

Breakwater & Frankford.

Work is progressing on the extension of this road from Selbyville, Del., southward to a connection with the Worcester Railroad near Berlin, Md., and it will be ready for travel in a short time.

Suncook Valley.

At the annual meeting, May 27, the directors were instructed to complete as soon as possible the new connection with the Concord road at Hooksett, N. H., which will be more direct than the present one. The surveys have already been made.

Leavenworth, Lawrence & Galveston.

The District Court of Douglas County, Kan., has decided that that county is entitled to a return from this company, of the bonds issued to it by said county, or to a judgment for their par value, with interest, which will amount to considerably over $400,000.

The county had originally made an agreement to subscribe stock to the railroad company, and issue $300,000 in bonds therefor. Afterward some of the commissioners gave the bonds of the county without receiving any stock, and on an agreement that the company need never give any stock for said bonds.

The judgment of the court is that the county of Douglas recover of the railroad company $300,000, the value of the bonds issued, and $104,000, the amount of interest paid by the county, together with interest at 7 per cent. per annum on the latter amount from the various times of payment, and at this same rate on the $300,000 from the time that interest has not been paid.

Chicago, Burlington & Quincy.

This company has reduced all passenger fares on its Iowa lines to the rate of 3 cents per mile, in conformity to the railroad laws, which was recently decided to be valid and constitutional.

Meetings.

The following companies will hold their annual meetings at the times and places given:

Chicago & Southwestern, at the east end of the Leavenworth Bridge, June 9, at 10 a. m.

Ogdensburg & Lake Champlain, in Malone, N. Y., June 22.

Missouri Railroad Commission.

The new Commission has been in session for several days, preparing a form of questions and report to be submitted to the railroad companies of the State.

Missouri Railroad Bridges.

The bridges over the Missouri River, connecting Western Missouri and Kansas, all seem to be in a bad way. It is reported, from Leavenworth, that the Kansas City bridge has had one or two of its piers badly damaged, and is so unsafe that it will have to be abandoned until a new pier can be built. At St. Joseph, the river, in spite of the dykes, is said to be surely cutting out a new channel which will leave town and bridge by a slough some three miles from the river. The Leavenworth bridge is safe, but is of so little use that there is talk of taking it down, removing it to a location nearer the city, and adding a draw span.

St. Louis, Alton & Terre Haute.

In view of the fact that only one-third of the directors of this company are elected each year and that this year the terms of all the New York members of the board, who are the real managers, will expire, an effort is being made by certain parties to secure a change in the board. A circular has been issued which charges that, in the reorganization of 1862, there were $284,000 of bonds left which have never been properly accounted for, and which, it is claimed, the reorganization committee divided among themselves. It is also charged that the company pays too high a rent for the leased Belleville & Southern Illinois road, and that the real owners of that road are the New York directors. Lastly, it is charged that the officers refuse information to parties interested.

A meeting of stock and bondholders was held in New York, May 29, and it was resolved to appoint a committee to demand from the officers of the company a list of voting bondholders, and, if refused, to take legal measures to secure it; to obtain proxies to be voted for members of the board of directors who will cause an investigation to be made of the matters referred to above, and to require from the present officers an explanation of those matters.

Messrs. Wm. C. Whitney, Wm. F. Mott and Charles C. Lamennais, were appointed the Committee.

Northern Pacific.

A circular has been issued urging various objections to the foreclosure as it has been conducted, and to the order of sale made by the Court. It asserts, what indeed is plainly apparent, that the proceedings thus far have been entirely in the interest of the parties who have built and managed the road. It asks bondholders to send proxies to the signers to enable them to apply to the Court for a modification of the order of sale in the interests of the bondholders, which are now subordinated to those of the floating-debt creditors, and also for permission to pay for the road in bonds in case it is bought in by the bondholders or any combination of them.

The circular is signed by Silas Casey, Wm. S. Shurtleff, N. W. Doughty, Charles W. Hassler, Edgar McCray and James Risk.

Wilmington & Reading.

At their meeting, held May 31, the stockholders voted to ratify the agreement of consolidation with the Baltimore, Philadelphia & New York Railroad Company. That company met May 29 and also voted to ratify, and the consolidation is complete. This action will have no present effect on the road, as it is now in the hands of the trustees under the second mortgage.

The Baltimore, Philadelphia & New York Company was itself a consolidation of the Maryland & Pennsylvania and the Juniata & State Line companies. It has no road completed, but has done some grading on a line from Baltimore to Philadelphia.

Central, of Iowa.

In the foreclosure suit the United States Circuit Court has made an interlocutory order appointing Lewis Fisher Master to report to the Court the amount of the bonds issued and outstanding of first, second and third-mortgage bonds each. Also, whether said bonds were legally and properly issued and sold in the market for a valuable consideration. Also, how many bondholders (and how many dollars are represented by said bondholders) have expressed a claim for a strict foreclosure, preserving the priorities of liens as they now are, or may so express their preference before the making of such report, and how many have expressed, or may express before such report, a preference for a foreclosure and sale for cash. Also, that such Master report such other and further information as will enable the Court to enter a final decree in this case.

By a strict foreclosure is meant a foreclosure and transfer to a new company without a sale.

In making the order the Judge remarked that a forced sale would probably involve a great loss; that in view of the various interests involved, he would feel warranted in making such a disposition of the property as might seem equitable, giving priority to the various interests in their proper order. He hoped that there would be such unanimity of action as would warrant him in turning over the property to a new corporation at the next term of court, but if there was not he would then appoint a new receiver.

The trustees made affidavit that the holders of nearly $1,000,000 of bonds had signified their desire to enter into the St. Louis, Iowa & Minnesota, the new company organized to take the road.

Mr. A. L. Hatch has issued a circular calling the attention of bondholders to these matters.

New York & Oswego Midland.

The Utica committee has likewise issued a circular, urging bondholders to subscribe to their plan, and pointing out the defects in the others, and deprecating the personal quarrels which have brought about the difference between the two New York committees.

A through train, passenger and fast freight, is now running between Middletown and Oneida, and a mixed train between Oneida and Oswego.

Hanover & York.

The last rail has been laid on this road and it will be ready to open for travel in a few days, when it will be opened by an excursion over the line. The road is 18 miles long, from York, Pa., southwest to Hanover, where it connects with the Littlestown Railroad and through that with the Frederick & Pennsylvania Line road, the three forming a pretty direct line from York, Pa., to Frederick, Md. They are all leased and will be operated by the Pennsylvania Railroad Company.

The grading of the new road has been done by contractors Rehill & McTague, J. F. Frederick, N. F. Flengel and Col. Cyrus Diller. The largest bridge, that over Codorus Creek, was built by the Watson Manufacturing Company. Mr. Jos. S. Gitt is the Chief Engineer. The cost of the grading and bridging was about $160,000.

Burlington, Cedar Rapids & Minnesota.

The United States District Court for Iowa has appointed Mr. W. W. Walker Receiver. The appointment is made on the application of Charles L. Frost, Trustee of the main line bonds, and Henry Clews and P. C. Calhoun, Trustees of the Milwaukee Branch bonds, pending a suit for foreclosure of mortgages on those divisions. A hearing of the case is to be had in the latter part of June.

Mr. Walker has received his instructions from the Court, and given the required bonds and taken possession of the property as Receiver.

Missouri Railroad Taxation.

A special dispatch from Jefferson City to the St. Louis *Republican* says: "The State Auditor has received official information that the Collector of Cass County has seized the passenger cars of two trains of the Missouri Pacific Railroad for taxes due and unpaid for the year 1873, amounting to $25,000. The State Auditor is determined to have the railroad tax question settled at once so that the State may receive the benefit of the $480,000 railroad taxes as early as possible. All legal efforts made by county collectors to collect railroad tax by seizure of property will be sustained."

Union Pacific.

The company has filed the necessary bond and taken out a writ of error to the United States Supreme Court, from the decision of the Circuit Court that the legal terminus of the road is on the Ohio side of the Missouri River.

The Court of Claims has announced its decision in the cases between this company and the United States. There were two suits, one brought by the company to recover one-half of the money due from the Government for mails and government freight. In this case the company acknowledged the right of the Government under the act of 1864 to retain half the amount due for transportation, but contest the validity of the act of 1873, which directed that the whole amount should be withheld. The other suit was brought by the United States to recover money paid by it for interest on its bonds issued to the company as a subsidy. The Court decides both suits in favor of the company, holding that by the original contract the Government has no right to withhold more than half

the amount due on government business, and that the company is entitled to recover the amount heretofore retained. Judgment is given in favor of the company for the sum of $512,432.50.

As to the cross-claim for interest paid, the Court sustains the position heretofore taken by the company and holds that there is nothing in the statute which makes any distinction between principal and interest, or indicates that the debt for the one shall mature before that for the other; that is, that the company is not bound to refund the interest paid by the government until the bonds mature and the principal becomes due.

The Railroad War.

President Garrett, of the Baltimore & Ohio, was in Chicago recently and made a statement of his views to a reporter, which is given as follows in the Chicago *Tribune:*

"In regard to the railroad war, Mr. Garrett said that it depended entirely on the Pennsylvania Railroad managers to terminate the present conflict. As far as he was concerned, he would never move an inch from the position he had taken. As soon as the right was conceded to his road to enter New York over the Pennsylvania Railroad, as he had been doing for thirty years, and to make such rates from Baltimore and Chicago as he chose, he was ready for peace, and not sooner. He would not meddle with the rates from Philadelphia and New York, and would be willing to maintain any rate the roads at those points should adopt. He cared but little for the New York and Philadelphia traffic, his principal object being to make Baltimore the principal outlet for the produce from the great West. Since the completion of his road to Chicago, the business of Baltimore had received a great impetus, and property in that city had largely advanced in value. The Saratoga combination, which had been gotten up to ruin the Baltimore & Ohio Railroad, had only served to establish the road and give it a standing in the West which otherwise it could not have obtained for many years. It had been and was now his firm object to maintain the freight rates on fourth class, the principal freight shipped from the West, at 35 cents per 100. This was a reasonable rate, and gave his company a fair profit. The other lines had to submit to this rate or there could be no peace. They might go above or below this figure if they chose, but he would not be coerced by them into making a rate to suit them. He intended to manage his own business, and not have it managed by others. It was the interest of the people of the West to support his road, for otherwise reasonable rates could not be maintained. The passenger rates were now below a paying figure, and would be raised again after the restoration of peace. But under no consideration would he consent to raise them again to what they were before the war commenced. As far as the Baltimore & Ohio Railroad was concerned, it could stand war any length of time. Its financial condition never was better than at present, and the earnings were daily increasing; still he regretted that the war was severely injuring other lines and destroying American railroad securities abroad. The Erie Railroad was now in such bad financial condition that it would be forced into bankruptcy before long. The Pennsylvania Railroad, though still bragging about its earnings, was not making money. The road had been losing immense amounts since the war began, and such little exhibitions of petty spite as refusing to carry the United States mail from the Baltimore & Ohio depot would help it but little. He had a letter from the Postmaster General in regard to this matter, a few days ago, stating that if the Pennsylvania Railroad insisted upon this measure, the government would also withdraw the Western mails from that road. Though this war was at present injuring a great many interests, still it was his opinion that in the end it would prove a great blessing and establish the railroads in this country on a sounder and firmer basis than they had been on heretofore." The statement with rrgard to the Western mails has subsequently been denied, and Mr. Garrett says that his words were not correctly reported in that respect.

Pittsburgh & Lake Erie.

The projected new line from Pittsburgh to Lake Erie, which is understood to be intended as an extension of the Connellsville road, has taken form so far that an organization has been completed and articles of incorporation have been filed with the Secretary of State of Pennsylvania. The route specified is from the Connellsville depot in Pittsburgh across the Monongahela and along the south bank of the Ohio to the mouth of Beaver, then across the Ohio and up the Beaver River to Newport in Lawrence County; thence to the mouth of the Mahoning River and up that river to the Ohio State line. This would bring it to a point about 120 miles in a straight line a little south of east of the present eastern terminus of the Baltimore, Pittsburgh & Chicago road.

Southwest Pennsylvania.

Contracts have been let for the bridges over the Youghiogheny and Mount's Creek, and the other work necessary to complete the extension from Connellsville to Mount Braddock. Part of the track was laid last year.

Kansas City & Southern.

This company has been organized to build a narrow-gauge railroad about 65 miles long from Kansas City, Mo., southward to the coal fields of Bates County, Mo. It is to be eventually extended to the Joplin lead mines.

Oil Creek & Allegheny River.

A new issue has been opened in the foreclosure suit, a question having been raised as to the jurisdiction of the Supreme Court under the new Pennsylvania constitution in the case of corporation mortgages. Arguments in the matter were heard at Harrisburg last week, and decision was reserved. If the decision is against the jurisdiction of the Court, the foreclosure decree will probably be declared void, and the proceedings will have to be gone over again.

St. Paul & Sioux City.

This company has filed with the Secretary of State of Minnesota the necessary papers for a change in the capital stock. The various series of preferred stock now outstanding are to be retired, and in place thereof there is to be one issue of consolidated preferred stock, as was recommended by the directors in their annual report.

Central, of Minnesota.

Engineers are now engaged in running a line from Albert Lea, Minn., to Northwood, Ia., for the extension which is to connect this road with the Central of Iowa. From Wells, the southern terminus of the Minnesota road, to Albert Lea, the track of the Southern Minnesota will be used.

Lafayette, Bloomington & Mississippi.

The bondholders of this company and the Lafayette, Muncie & Bloomington held a joint meeting in New York, May 28, to devise means to protect their interests. Both roads are leased to the Toledo, Wabash & Western, and the interest on their bonds has been in default since February 1. After some discussion a committee, consisting of Henry K. Sheldon, John T. Martin, E. K. Lyman, S. B. Chittenden, Jr., and George J. Sinsy, was appointed to devise measures to secure the rights of the bondholders.

September 30, 1871, the Lafayette, Muncie & Bloomington Railroad Company and the Lafayette, Bloomington & Mississippi Railroad Company entered into a contract whereby the directors of the first-named company transferred the entire property known as the Western Division of the Lafayette, Muncie & Bloomington to the Lafayette, Bloomington & Mississippi Company. The contract was subsequently transferred to the Toledo, Wabash & Western Railroad Company. In a suit brought by the Commissioners of Tippecanoe County, the Indiana Supreme Court has just decided that there is nothing in the acts of the Legislature bearing on the case to authorize such a contract; that the directors have no power to make it; that it is in violation of the stockholders' rights, and in contravention of public policy.

Atlanta & Richmond Air Line.

Mr. John H. Fisher, the Receiver appointed by the United States Circuit Court for Georgia, recently applied to the United States District Court for South Carolina to be put in possession of the road in South Carolina, now held by Gen. A. S. Buford as Receiver under orders of the latter court. After hearing argument Mr. Fisher's petition was denied.

Southern Minnesota.

The general freight and ticket offices have been removed from Wells, Minn., to La Crosse, Wis., where they will be permanently located. The Auditor's and Treasurer's offices will remain at Wells for the present.

Green Mountain Narrow Gauge.

The projectors of the roads heretofore known as the Deerfield River, the Montpelier & Rutland and the Montpelier & Shelburne Falls, have united and organized a new company by the above name under the general law of Vermont. The road is intended to run from Deerfield or Shelburne Falls, Mass., northward to Montpelier, Vt., and eventually to the Canada line.

Rockford, Rock Island & St. Louis.

Mr. H. W. Bishop, Master in Chancery, has submitted to the United States Circuit Court his report on the property of the company and the claims against it. The length of road owned by the company is 275.8 miles, and it leases several short sections owned by other parties. Besides the depots and three engine houses there are at Beardstown a car-shop, blacksmith shop, machine shop and round-house. The equipment consists of 30 engines, 14 passenger, 15 way and 6 baggage and mail cars; 391 box, 99 stock, 90 flat and 317 coal cars. The real estate, outside of the right of way, consists of some coal land, valued at $27,200. Mr. Bishop places the value of the whole property at $1,000,000, and thinks the greatest sum can be realized by selling it in one parcel.

The report rehearses the manner in which the bonds were sold. The first series of 5,000 bonds are a first lien upon 120.8 miles of road and nearly all the real estate; the second series of 4,000 are a second lien upon that section, and both series have an equal lien on the remaining 155 miles. All were sold and described as first-mortgage bonds. Of the second series $1,500,000 were sold in denominations of $500 and $100, the holders having the right to exchange them for $1,000 bonds at any time. Of the first series $4,999,000 are outstanding, of which $4,338,000 were included in the scaling-down agreement by which the bondholders agreed to accept one-half the face value of the coupons and to receive preferred stock for half the face of their bonds, and to fund the over-due coupons. Of the second series the whole $4,000,000 were issued, of which $3,686,300 were included in the agreement. This agreement, however, has been rendered void by the foreclosure.

The amount of principal and over-due interest is reported as follows:

First series of bonds	$6,286,069 28
Second	5,047,425 62
Total	$11,333,494 90

Of the first series $31,850 and of the second $50,109 are contested; both claims are held by Messrs. Max and Henry Budge, Jacob H. Schiff and Geo Lehmer. A number of intervening claims of bondholders were presented and proved.

The Master recommends the allowance of claims amounting to $42,506.95 to the trustees for services, expenses, etc.; of $7,500 to the counsel for the bondholders, and of $900 to the counsel for three other parties.

The Union Trust Company, trustee, has taken exception to the Master's report, claiming that the property on which the first series of bonds is a first lien includes only the main line from Sterling to Rock Island, the road from Keithsburg to Sagetown and the Cleveland Branch, 61.8 miles in all. The Master's report was that the portion of the main line covered by that lien extended to a point seven miles north of Monmouth, making 120.8 miles in all.

The sheriff of Greene County, Ill., at Carrollton, May 28, levied upon a freight train for taxes due the county, the Receiver having refused payment. The railroad people refused at first to submit, but finally yielded and allowed the sheriff to retain possession, the question of his right to do so being referred to the United States Circuit Court, under whose direction the Receiver is operating the road.

Marquette, Houghton & Ontonagon.

The summer time-table of this road shows, besides an express and mail train running through from Marquette to L'Anse and an accommodation from Marquette to Michigamme, 10 regular ore trains each way on the Eastern Division (Marquette to Ishpeming). On the Middle Division (Ishpeming to Michigamme) there are five ore trains each way, of which four run between Ishpeming and Humboldt and one between Ishpeming and Champion. The Western Division (Michigamme to L'Anse) has two ore trains each way. On the branch from Ontonagon Junction to Goodrich there are seven ore trains each way, and on that from Humboldt to Republic four.

San Luis & Santa Maria Valley.

The two rival companies which had each begun the construction of a railroad from San Luis Obispo, Cal., to Avila, the San Luis Obispo and the San Luis & Santa Maria, have been consolidated under the above name. Operations have been almost suspended, and the company has asked for a subsidy from the town of San Luis Obispo.

Montclair.

The bondholders' committee gives notice that bondholders are requested to deposit their bonds with the New York State Loan and Trust Company, No. 50 Wall street, New York, on or before June 8, in order to participate in the reorganization on that day.

Pueblo & Arkansas Valley.

A large amount of material has been collected at Granada, Col., for use on this extension of the Atchison, Topeka & Santa Fe, and tracklaying was begun May 29.

Mobile & Ohio.

The bondholders have filed a petition in foreclosure in the United States District Court at Mobile, Ala.

Denver & Rio Grande.

The Franco-American Guarantee Society, Belgium Delegation, advertises in the *Moniteur des Interets Materiels*, of Brussels, that it will sell the 7 per cent. mortgage bonds of this company, payable in annual drawings within 46 years at the maximum, issued at the rate of $25,000 per mile, for the purpose of paying for an extension of the present road from the present southern terminus at Pueblo southward 100 miles to Trinidad. Besides the security of the road and its income, the advertisement says that these bonds are guaranteed by the Franco-American Guarantee Society, which has a capital of 10,000,000 francs, and by half of its net profits. The price is 5,200 francs per $1,000 bond, which is very nearly par in gold. An issue at this rate will require net earnings at the rate of $1,750 gold per mile to pay the interest, or, at the present price of gold, a little more than $2,000 currency. In 1874 the earnings of the completed part of the road, in the more thickly peopled part of the territory, were $3,141 gross per mile; in 1873, $3,271; and the net earnings were probably about half as much. The new part of the road could not be expected to earn as much as the old part for some time to come.

Atchison, Topeka & Santa Fe.

At the annual meeting in Topeka, Kan., the stockholders voted to ratify the contract for the construction and lease of the Pueblo & Arkansas Valley road, which will extend this road to Las Animas at once, and eventually to Pueblo.

Rates on Eastward Bound Freight.

At the adjourned meeting of the General Freight Agents' Association, in Chicago, May 27, the following rates on Eastward bound freight were adopted, those given being per 100 pounds on fourth-class freight:

From	New York.	Boston.	Philadelphia.	Baltimore.
Chicago, to	30 cents.	35 cents.	25 cents.	25 cents.
Indianapolis	27½ "	32½ "	25 "	22½ "
Cincinnati	25 "	30 "	22½ "	20 "
St. Louis	35 "	40 "	32½ "	30 "
Peoria	35 "	40 "	30 "	30 "
Terre Haute	30 "	35 "	27½ "	25 "
Evansville	35 "	40 "	32½ "	35 "
Springfield, Ill	40 "	45 "	37½ "	35 "

The meeting was not fully attended, and it is not believed that the rates agreed upon will be strictly adhered to.

Rockford Central.

This railroad from Rockford southward to Rochelle is reported by the Rockford *Register* to be nearly all graded and ready for the rails. It reports, too, that tracklaying is soon to be begun at a rapid rate.

Easton & Amboy.

This road was completed May 27, when the last rail was laid in the Musconetcong Tunnel. The next day, May 28, the first through train started from Easton. It consisted of an engine and 124 loaded coal cars, and was followed by a passenger train with a number of officers of the road. Stops were made at all the stations, and about six hours were occupied in the passage. The road will be formally opened to traffic in a week or so.

The new railroad is 61 miles long and extends from Easton, Pa., across New Jersey to Perth Amboy, where extensive coal docks have been erected. It has been built by the Lehigh Valley Company, and will be leased and worked by that corporation. It is intended mainly to take coal to tide-water, and is well adapted to carry a heavy traffic cheaply, its grades being very light, with no sharp curves. It is very substantially built, is laid with steel rails, and work on a second track is well advanced. There is some heavy work on it, notably the great tunnel through the Musconetcong Mountain near Pattenberg, which is within a few feet of a mile long and was cut most of the way through solid and extremely hard rock.

The passenger travel will not go through to Perth Amboy, but will be transferred to the Pennsylvania Railroad at the crossing of the two roads at Metuchen, where a connecting switch has been put in, and will go to New York over that road.

Hartford, Providence & Fishkill.

Surveys are being made for a branch from River Point, R. I., to Cowesett or Apponaug.

Knoxville & Charleston.

The lessees of this road having failed to put it in order or operate it, it is understood that the State of Tennessee has agreed to sell it to Major Thomas O'Connor for $75,000. As soon as the sale is completed, Major O'Connor will put the road in running order. The road is 16 miles long, from Knoxville, Tenn., southeast to Maryville.

Valparaiso, Crown Point & Western.

This company recently filed articles of incorporation with the Secretary of the State of Indiana. The road is to run from the junction of the Chicago & Lake Huron and the Pittsburgh, Fort Wayne & Chicago roads near Valparaiso, Ind., west through Crown Point to the Illinois line in Lake County, about 30 miles. The capital stock is to be $500,000, and the corporators are David Turner, Zerah F. Summers, Elisha C. Fields, Elihu Griffin, James H. Ball, D. F. Skinner, Dan A. Saylor, Luther H. Fisk and Marsh L. McClellan.

Sedalia & Arrow Rock.

It is proposed to build a railroad from Sedalia, Mo., northeast by way of Marshall to the Missouri at Arrow Rock, a distance of 44 miles. An old graded road-bed extends for some 14 miles of the distance.

Cleveland & Rocky River.

This company has been organized with a capital of $150,000 to build a suburban railroad from Cleveland, O., to Rocky River; a part of the present Rocky River Railroad is to be used.

Dunkirk, Allegheny Valley & Pittsburgh.

Surveys are to be made for a branch about six miles long from Falconer, N. Y., westward to Jamestown at the foot of Chautauqua Lake.

Concord & Portsmouth.

This company has resolved to abandon the use of wood, and its engines are all to be changed to coal burners. A coal dump and storehouse are being built on the Portsmouth docks.

A new union depot is being built at Epping, N. H., the crossing of the Nashua & Rochester road.

ANNUAL REPORTS.

Mobile & Ohio.

This company owns and works the following lines:

	Miles.
Main line, Mobile, Ala., to Columbus, Ky.	472
Gainesville Branch, Narkeeta, Miss., to Gainesville, Ala.	21
Columbus Branch, Artesia, Miss., to Columbus	14
Okatibbeha Branch, Artesia to Starkesville	11
Aberdeen Branch, Muldon, Miss., to Aberdeen	9
Total	527

During the year 6¼ miles of the Okatibbeha Branch were built, completing that line.

The track is stated to be generally in good condition, and during the year 27½ miles of new rails and 260,789 new ties were used in repairs. A new 18-stall round-house at the Whistler shops was built.

The equipment consists of 93 engines, 8 first-class, 22 second-class and one special passenger car, 11 baggage and mail and 6 express cars, 671 box, 242 platform and 36 stock cars.

The property is represented by the following capital account:

Capital stock ($10,096 per mile)	$5,320,600
First mortgage and funded interest bonds	9,648,220
Second mortgage bonds	1,453,848
Gainesville Branch bonds	83,000
Convertible bonds	977,550
Total bonded debt ($23,022 per mile)	$12,132,618
Floating debt ($2,214 per mile)	1,166,493
Total ($35,332 per mile)	$18,619,710

The cost of road and equipment is stated at $18,126

This has been increased $823,703 since last year, but the increase is only apparent, owing to a change in the system of keeping the accounts, the balances carried to the debit of the branches and of the improvement account having been transferred to the general construction account. The company owns $351,700 of its stock, $713,550 of its bonds and $153,500 town and county bonds. The company owns 1,192,464 acres of land, and there were but few sales during the year.

The floating debt consists of $834,876 bills payable; $302,543 Auditor's and pay-roll warrants, and $29,073 overdraft. The materials on hand amount to $316,333.

The income account for the year was as follows:

Cash on hand, December 31, 1873		$25,500.22
Net earnings for year		707,865.04
Uncollected earnings from 1873		89,874.10
Interest on bonds owned		69,994.18
Sale of county and convertible bonds		93,850.00
Sale of old material		33,996.00
		$1,021,079.55
Less uncollected earnings, including mail		137,600.06
		$883,479.49
Interest on funded debt	$337,267.05	
" " floating "	118,346.97	
Decrease in outstanding warrants	50,602.31	
Sundry old claims and balances	23,051.07	
Okatibbeha Branch	45,000.00	
Paid on account of floating debt	281,948.85	
		856,216.25
Cash balance		$27,263.24

The payments on account of floating debt were made to prevent the sacrifice of securities owned by the company. Since the close of the year covered by the report the company has failed to pay the March interest on the second-mortgage and the May interest on the first-mortgage bonds, and the road is now in the hands of the trustees under the first mortgage.

The earnings for the year ending December 31 were as follows:

	1874.	1873.	Inc. or Dec.	P. c.
From passengers	$429,630 86	$596,605 14	Dec. $166,974 28	28.0
Freight	1,838,923 52	2,074,794 84	Dec. 235,871 32	11.4
Mails	61,727 40	61,727 40		
Express	60,737 50	68,000 00	Dec. 7,262 50	10.7
Total	$2,391,019 28	$2,801,127 38	Dec. $410,108 10	14.6
Repairs of road	473,632 43	529,347 85	Dec. 55,715 42	10.5
Rep'rs of machin'y	404,015 77	552,037 21	Dec. 148,021 44	26.8
Conducting transportation	731,490 87	865,378 47	Dec. 133,887 60	15.5
General expenses	74,015 17	77,207 04	Dec. 3,191 87	4.1
Total expenses	$1,683,154 24	$2,023,970 57	Dec. $340,816 33	16.8
Net earnings	$707,865 04	$777,156 81	Dec. $69,291 77	8.9
Gross earnings per mile	4,537 03	5,418.64	Dec. 881 01	16.3
Net earnings per mile	1,355 15	1,503 20	Dec. 148 05	9.9
Per ct. of expenses	70.39	72.26	Dec. 1.87	2.6

The work done during the year was as follows:

	1874.	1873.	Inc. or Dec.	P. c.
Passenger train mileage	419,438	540,636	Dec. 121,198	22.4
Freight " "	611,307	676,626	Dec. 65,319	9.7
Other " "	261,982	289,759	Dec. 27,777	9.6
Total train mileage	1,292,727	1,507,021	Dec. 214,294	14.2
Passengers carried one mile	9,570,286	14,183,438	Dec. 4,613,152	32.5
Tons freight moved one mile	52,100,458	54,201,548	Dec. 2,101,090	3.9

In 1874, 49.1 per cent. of the passenger mileage, and 73.2 per cent. of the tonnage mileage was of business bound southward. The average receipts per passenger per mile were 4.49 cents; per ton per mile, 3.53 cents.

The cost of engine service per mile was on the Southern Division, 29.7 cents; Middle Division, 27.6 cents; Northern Division, 33.3 cents.

The directors' report says that a policy of strict economy has been pursued. With the close of the year the warrant system was abandoned, and the labor will hereafter be paid for in cash, and the supplies, as far as possible, bought for cash. The decrease in earnings was largely due to the completion of the Mississippi Central, a competing line, through to Cairo.

Tests of Abrasion and Wear.

The United States Board to test Iron, Steel, etc., appointed by the President of the United States, in accordance with Section 4 of the Act of Congress, making appropriations for sundry civil expenses of the Government, and approved March 3, 1875, has assumed, as a part of its work, the investigation of the methods and effects of abrasion and wear of metals in engineering and mechanical operations.

This Committee is instructed to take up this subject and to report such valuable data and stastistics, and such information as it may acquire by experiment or from other observers, in such form that it may be readily collated and made useful to the Government, the public, and the engineering profession.

The Committee would be pleased to receive from any reliable source such precise data and such information as may enable the Secretary to compile, in as concise and exact form as possible, a statement of the mode of deformation, the rapidity of abrasion and the laws governing wear in any important typical or exceptional cases.

The executive officers of all lines of railway may render valuable aid by furnishing statements of the wear of rails per ton of transportation, specifying with care the original weight, the make and the character of the rail, the total amount of transportation, the length of time occupied, and stating whether the rail finally broke or was removed. Specimens of rails remarkable either for endurance or for a lack of this quality, if sent to the Committee, will be of use in assisting in the determination of the chemical and other properties which most affect the value of the material under the stated conditions of use.

Similar statistics and information in regard to the wear of wheels, axles and other parts of rolling stock and machinery will be equally valuable.

Engineers having in any instance noted and accurately recorded such data are requested to transmit to this Committee copies of their memoranda.

The wear of journals under heavy loads, or at high velocities, as well as under ordinary conditions, is an important branch of this subject. When possible it is desired that the dimensions of the journal, the maximum, the minimum and the mean weight sustained, and the velocity or rubbing or number of revolutions per minute should be given. The nature of the lubricant is an essential element, and its composition should be stated, the method and frequency of application and the quantity used should be given. When known or readily ascertained, the coefficient of friction should be given. It should also be noted whether heating occurs, and under what circumstances of pressure and velocity of rubbing surfaces.

Peculiar instances of the behavior, or unusual expedients in the management of bearings, if described accurately and concisely, will be accepted, with thanks.

The wear of tools under the various conditions of workshop practice is another subject of investigation.

Weighing the tools carefully before and after use and weighing the amount of metal removed will, perhaps, be found the most accurate method of determining the rate of abrasion. The area of surface finished and the area of the surface cut by the tool should be accurately ascertained and stated.

The description of the tools its shape, method of operation, the kind of metal used in the tool, the temper adopted, the character of the metal cut by it, the velocity of the tool, and where peculiarities of behavior were noted, a careful statement of them should be given. This information will be still more valuable if the tool itself and specimens of the chips produced by it are furnished.

The power required to drive the tool can sometimes be readily determined, and such information is of great value.

The recent investigations of M. Tresca—*Memoir Sur le Robotage des Metaux, etc.*—is an excellent example of such research.

For all information which may properly fall within the limits of their investigation this Committee will return suitable acknowledgment.

R. H. THURSTON, Chairman.

R. H. THURSTON,
A. L. HOLLEY,
D. SMITH, U. S. N.,
} Committee.

LOCOMOTIVE RETURNS, JANUARY, 1875.

Master Mechanics of all American railroads are invited to send us their monthly reports for this table.

NAME OF ROAD.	Number of miles operated	Number of Locomotives in service	Mileage	No. Miles run to Ton of Coal	No. Miles run to Cord of Wood	No. Miles run to Pint of Oil	Av'rage No. of Freight Cars Hauled	Cost per Mile in Cents for Repairs	Fuel	Stores	Miscellaneous	Engine'rs, firemen and wipers	Total	Av'ge cost of Coal, per ton	Av'ge cost of Wood, per cord
Allegheny Valley	259	60	115,662	33.00	.....	18.60	.....	5.75	4.95	0.96	.....	7.98	19.64	$1.48	$2.70
Atlantic & Great Western (First & Second Div.)	228	89	186,226	37.53	.....	19.87	.....	5.37	6.27	0.53	0.99	6.34	19.50	2.21	3.23
" " (Third & Fourth Div.)	197	50	105,990	37.53	.....	20.53	.....	5.02	6.27	0.45	1.05	6.09	18 88	2.21	3.22
" " (Mahoning Division)	121	58	105,947	37.53	.....	20.00	.....	3.97	6.27	0.43	0.70	6.08	17.45	2.21	3 22
" " (Shenango & Allegheny)	33	9	14,180	49.06	.....	25.09	.....	1.70	4.07	0.34	0.97	5.89	12.97	2 00	2.35
Camden & Atlantic	67	11	15,631	63.37	.....	21.50	.....	8 63	8.72	0.85	.....	5.89	24.09	5.37	4.00
Central Pacific (Western Division)	173.4	42	113,391	41.05	.....	17.35	.....	6.02	19.37	0.79	0.57	8.22	34.97	7.84	5.60
" " (Sacramento Division)	119.5	39	83,812	.....	29.56	14.28	.....	11.89	16.91	0.92	1.03	8.92	39 67	.....	5.00
" " (Truckee Division)	204.5	26	63,762	34.58	28.77	15.57	.....	8.14	19.94	0.74	0.76	8.79	38.37	7.84	5.00
" " (Humboldt Division)	236.6	22	62,854	38.35	.....	16.81	.....	5.25	20.05	0.70	0.40	7.85	34.25	7.84	5.00
" " (Salt Lake Division)	182.8	23	63,063	35.89	.....	17.82	.....	11.44	21.42	0.73	0.57	7.92	43.08	7.84	5.00
" " Oregon Division)	151.48	7	20,227	.....	40.62	26.83	.....	2.24	12.31	0.55	0.38	8.39	23.87	.....	5.00
" " (Visalia Division)	188.3	15	33,154	51.89	50.00	18.55	.....	7.21	15.18	0.68	0.03	6.52	29.67	7.84	5.00
Chicago, Burlington & Quincy (Aurora Div.)*	.....	163	216.346	.....	.....	.....	21.15	.....	.....	.....	.....	.....	33.75	2.50	4.25
" " " (Galesburg Div.)*	.....	91	216,293	.....	.....	.....	17.28	.....	.....	.....	.....	.....	26.55	2.50	4.25
" " " (Burlington Div.)*	.....	38	94,910	.....	.....	.....	14.60	.....	.....	.....	.....	.....	34.88	2.50	4.25
" " " (Creston Div.)*	.....	70	170,270	.....	.....	.....	8.68	.....	.....	.....	.....	.....	22.61	2.50	4.25
Chicago, Rock Island & Pacific (Illinois Div.)	.....	91	214,832	33.28	.....	14 60	.....	4.57	8.41	0.51	.....	5.99	20.48	2 75	3.50
" " (Iowa Division)	.....	76	188,664	26.99	.....	13.50	.....	5.07	10.34	0 54	.....	6.68	22.63	2.75	3.50
" " (Southwestern Div.)	.....	46	113,852	33.98	.....	11.91	.....	4.30	8.25	0.62	.....	6.76	19 93	2.75	3.50
Cleve., Col., Cin. & Ind. (Columbus Div.)	138	56	133,658	38.89	60.34	41.62	.....	4.22	6.26	0.55	.....	7.18	18.21	2 40	3.50
" " " (Indianapolis Div.)	207	63	181,273	41.73	32.62	26.52	.....	4.48	6.00	0.60	.....	7.17	18.25	2.65	3.50
" " " (Cincinnati Div.)	130	28	71,416	37.61	.....	28.18	.....	3.00	5.98	0.52	.....	7.72	17.22	2.05	3.50
Cleveland & Pittsburgh	199	78	132,193	50.89	.....	18.08	.....	7.11	4.29	0.72	2.37	7.41	21.90	1.99	1.95
Del., Lacka. & West. (Bloomsburg Div.)	80	22	44,860	.....	.....	35.96	.....	4.70	.....	0.79	.....	6.48	11.97	.....	.....
Flint & Pere Marquette	289	...	101,051	.....	49.82	23.24	.....	12.50	9.12	0.59	.....	6.36	28.57	.....	4.50
Hannibal & St. Joseph	204	55	105,551	44.40	.....	19.30	.....	7.80	6.60	0.40	.....	7.20	22.10	2.75	4.00
Illinois Central (Chicago Div.)	252.5	65	160,718	34.99	.....	14.47	13.23	4.81	5.44	0.35	.....	6.79	17.41	1.80	4.25
" " (South Div.)	230.75	35	97,593	32.22	.....	13.87	15.53	6.26	5.89	0.38	.....	6.73	19.26	1.80	4.25
" " (North Div.)	225	46	107,394	28.50	.....	13.99	13.77	6.21	6.69	0.39	.....	6.76	20.05	1.80	4.25
" " (Iowa Div.)	401	42	100,174	30.23	.....	16.28	10.91	5.44	7.88	0.35	.....	6.72	20.39	2 30	4.75
Jeffersonville, Madison & Indianapolis	225	42	91,670	37.17	21.00	18.00	.....	3.70	6.62	0.46	2.79	6.92	20 49	2.23	3.20
Kansas Pacific (including Denver Pacific)	895	94	139,198	26.69	.....	10.59	.....	5.99	13.43	0 59	.....	9.35	29.36	3.55	3.24
Kansas City, St. Joseph & Council Bluffs*	253	25	67,373	39.20	.....	26.50	18.90	4.70	8.70	0.70	.....	7.80	21.90	3.15	4.00
Lake Shore & Michigan South. Buffalo Div.†	.....	93	202,369	41.20	49.20	14.66	.....	4.00	8.48	.....	.....	5.54	19.02	3.0	3.50
" " " (Erie Div.)†	.....	114	236,954	37.19	67.78	20.85	.....	5.89	9.42	.....	.....	6.55	21.86	3.50	4.00
" " " (Toledo Div.)†	.....	79	174,686	32.18	45.59	13.37	.....	5.48	11.92	.....	.....	6.39	23.79	4.00	4.00
" " " (Mich. South. Div.)†	.....	210	466,189	36 32	49.13	17.96	.....	4.24	10 61	.....	.....	6.96	21.81	4.50	3.50
Leavenworth, Lawrence & Galveston	203.7	18	20,211	54.30	.....	25.20	.....	6.60	7.13	0.34	.....	5.67	19.74	3.62½	3.50
Louisville, Cincinnati & Lexington†	238	....	73,393	43.75	15.0	22.75	.....	4.58	10 44	0.82	3.68	7.43	26.95	4.80 per bu	3.75
Pennsylvania (New York Division ‡	119.9	118	272,209	30.94	.....	10.18	21.60	6.60	15.00	1.20	.....	.....	22.80	0.16	6.86
" (Amboy Division)‡	154.2	52	79,444	47.97	.....	13.85	12.60	4.60	9.50	0.90	.....	.....	15.00	0.16	6.89
" (Belvidere Division ‡	102.5	33	49,244	48.29	.....	12.92	19.20	4.70	9.40	1.20	.....	.....	15.30	0.16	6.91
" (Philadelphia Division)‡	204.3	160	374,107	31.15	.....	14.05	19.50	3.00	5.70	0.80	.....	.....	9.50	0.06	3.52
" (Middle Division)‡	131.6	132	289,449	29.69	.....	19.61	29.10	4.90	5.90	0.60	.....	.....	11.40	0.06	3.52
" (Pittsburgh Division, East End)‡	.....	73	135,154	21.22	.....	11.99	13.70	10.30	8.20	0.90	.....	.....	19.40	0.06	3.52
" (Pittsburgh Division, West End)‡	.....	108	244 516	32.03	.....	3.62	16.50	6.70	5.40	0.80	.....	.....	12.90	0.06	3.52
" (Tyrone Division)‡	106.8	22	41.697	26.57	.....	24.75	9.20	8.20	6.70	0.50	.....	.....	15.40	0.06	3.52
" (West Pennsylvania Division)‡	103.6	25	44,904	39.62	.....	25.91	10.80	7.99	4.60	0.50	.....	.....	13.09	0.06	3.52
" (Lewistown Division)‡	12.5	4	3,368	51.91	.....	22.12	4.40	5.50	3.80	0.50	.....	.....	9.80	0.06	3.52
" (Bedford Division)‡	56.5	3	5,498	62.20	.....	26.88	6.50	1.80	3.00	0.40	.....	.....	5.20	0.06	3.60
Pitts., Fort Wayne & Chicago (Eastern Div.)	468.9	179	409,270	39.09	.....	15.24	.....	4.44	5.88	0.79	0.97	6.55	18.63	1.80pt	1.86
" " " (Western Div.)	280	110	292,363	39.50	.....	16.95	18.60	4.40	5.20	0.50	1.30	6.50	18.00	2.10pt	2.10
Pitts., Cin. & St. Louis (Little Miami Div.)	.....	37	96,917	42.76	.....	12.94	...	4.71	4.39	1.01	2.58	7.10	19.79	1.75pt	2.75
South Carolina	242	40	70,897	...	42.05	24.27	.....	7.42	6.20	0.76	.....	.....	14.39	.....	2.61
Stockton & Copperopolis	49	3	3,867	.....	61.63	12.20	.....	1.36	8.11	1.03	0.94	10.89	22 33	.....	5.00
St. Joseph & Denver City	266	....	36,039	34.80	.....	18.50	.....	3.09	9.10	0.50	.....	6.60	19.20	3.00pt	3.00

*Three empty c rs rated as two loaded ones. †Switching engines allowed 6 miles per hour. ‡Five empty cars counted as three loaded ones.

If we take for the limit of elasticity the condition of things at which no permanent set is obtained, the case is different. Thus it was found that the set which subsisted after the pine stick (3 inches by 3 inches, and 4 feet long) had been loaded at its middle with 200 pounds (1-10 of a breaking load), eventually passed off entirely. This was the case whether the stress was momentary or prolonged, and whether it was applied but once or repeatedly. It may accordingly be said that a practical limit of elasticity exists, but not a theoretical limit.

All the diverse phenomena of set, whether those which have now been under discussion as resulting from a transverse stress or those attendant upon direct tensile or compressive stresses, as determined by Hodgkinson, Chevandier and Wertheim, and other experimenters, seem to conduct infallibly to one conclusion—to one general conception, in which alone they find their sufficient explanation. It is universally admitted that all solid bodies are made up of ultimate molecules, in a condition of equilibrium, either statical or dynamical, under the operation of antagonistic forces of attraction and repulsion, either actual or virtual. Now it is plain that if this be true, and if, as we have seen, as the result of a series of increasing strains (by which the molecules are displaced by but minute fractions of their intervening distances), they take up a series of new positions of equilibrium, when the strains are withdrawn, differing by excessively minute degrees from those previously occupied, the effective forces exerted by the molecules on one another must suffer some change of intensity. Viewing the residual displacement of the molecules as a mechanical problem, we are constrained to regard the effective molecular forces, that take effect at a given distance, as having acquired a different intensity, either throughout the bar or at some one or more transverse sections.

In another paper read before the Academy, Prof. Norton gave new mathematical formulæ for the deflection of rectangular bars or beams resting on supports and subjected to a transverse stress.

Experiments on the Strength of Materials.

At the session of the American Academy of Science last April, a paper was presented by Prof. W. A. Norton, of Yale College, giving the results of a series of experiments made by him on bars of wood, iron and steel.

Prof. Norton submitted at the meeting of the American Academy, April 1, 1874, the results of an extended series of experiments on the residual deflection of rectangular bars of white pine after having been subjected to a transverse stress. He had since made a great number of similar experiments on bars of wrought iron and steel, the results of which were discussed in the present paper. The conclusions arrived at, after a very extended series of experiments, were that every application of a transverse stress to a bar must induce some change in its molecular condition which continues with variations that may be either progressive or fluctuating, for a greater or less interval of time. The duration of sensible influence varies with the amount and duration of the stress. For the smaller strains it is but a few minutes; for the larger, several days. The prolonged influence of strains applied from day to day to a bar was apparent from the fact that the same stress did not on different days produce either the same deflection or the same set. It was strikingly shown, in the experiments with the steel bar, by causing the bar to which loads had been repeatedly applied for several previous days to rest on its opposite side, and comparing the deflection and set with those obtained immediately before the reversal. It was found that the deflection produced by 18⅛ pounds was 1-16 greater than the deflection produced by the same weight just before the reversal, and the set obtained was now many times greater than before. The deflection also now increased with a prolongation of the strains, whereas it before decreased. The set also now increased after the load was removed, whereas it before decreased.

There was no discernable limit of elasticity, revealed by the experiments, with either wood, iron or steel. A perceptible set obtained, with each material, immediately after the stress was removed, however small its amount, until the set fell below the lowest possible determination of which the apparatus was capable (viz., 1-20,000 of an inch, as the experiments were ordinarily conducted). To test the question still further, the delicacy of the apparatus was largely increased; and it was found that the least perceptible immediate set was still limited only by the capability of the apparatus to detect minute displacements.

Suggestions Wanted for Tests of Iron and Steel.

STEVENS INSTITUTE OF TECHNOLOGY,
DEPARTMENT OF ENGINEERING, HOBOKEN, N. J., 1875.

The United States Commission has issued the following circular:

DEAR SIR: The Commission appointed by the President of the United States to experiment and report upon the metals used in construction, desires to secure the assistance of all who are interested in this great work, and through them to obtain all information available as the result of the labors of earlier, or of contemporaneous, investigators and observers.

I take the liberty of enclosing herewith circulars indicating the scope of the labors undertaken by this Commission, and beg that you will aid, by such methods as may be by you deemed best, in the collection of all information which may be accessible, relating to either the general work of the Commission or to the special subjects assigned to its committees.

Data collected in the course of ordinary business practice, and the records of special researches previously made or now in progress, are particularly desired.

It is expected that the Commission will receive valuable information and useful suggestions, both from business men and from men of science, and it is hoped that the work undertaken as here indicated may be supplemented by original investigations made by both these classes.

The national importance of this work justifies the expectation of an earnest and effective co-operation.

Very respectfully yours,
R. H. THURSTON, Secretary.